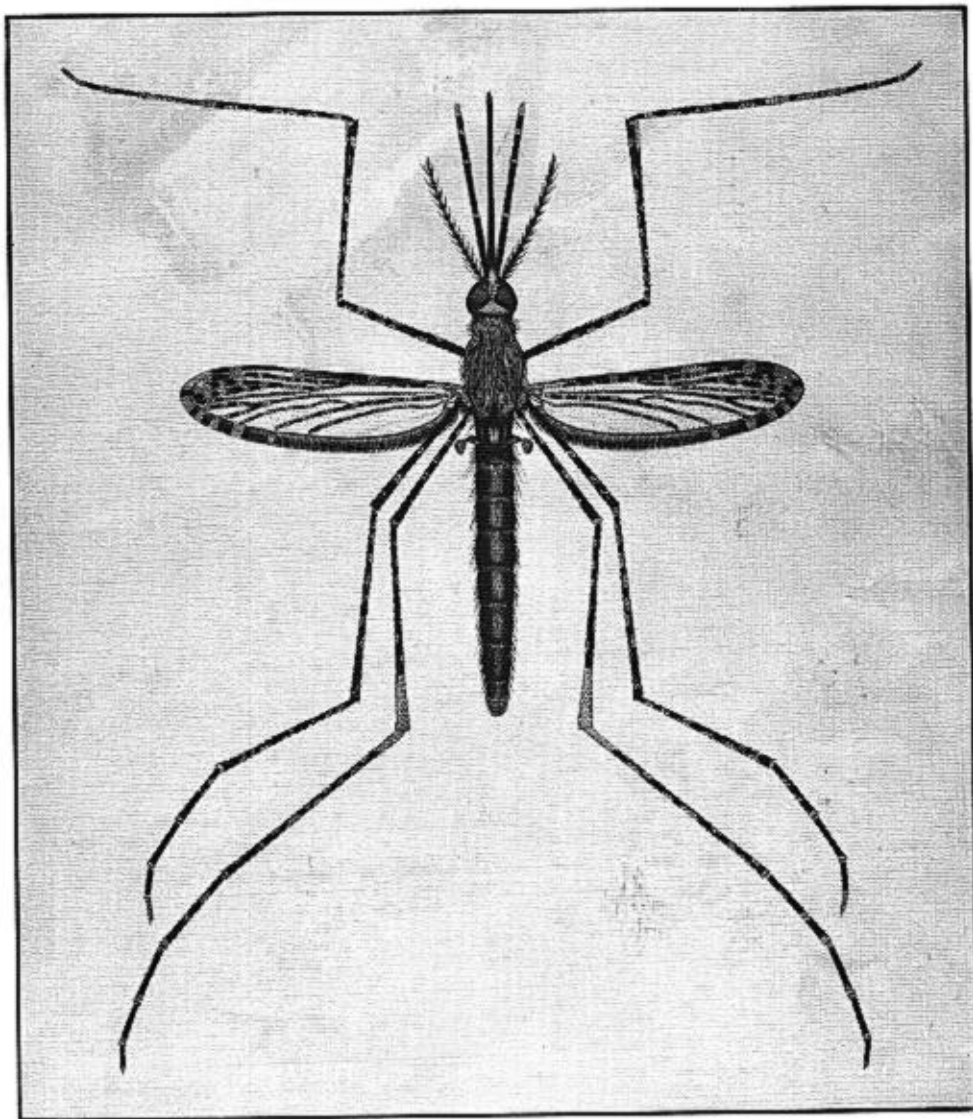


FILE

Brown ✓

**ILLUSTRATED KEY
TO THE FEMALE ANOPHELES MOSQUITOES
OF THAILAND**



**UNITED STATES ARMY MEDICAL COMPONENT
SOUTH EAST ASIA TREATY ORGANIZATION
BANGKOK, THAILAND.**



1966

25
22
47

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE SEP 1966		2. REPORT TYPE		3. DATES COVERED 00-00-1966 to 00-00-1966	
4. TITLE AND SUBTITLE Illustrated Key to the Female Anopheles Mosquitoes of Thailand				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Medical Component, Department of Medical Entomology, South East Asia Treaty Organization, APO San Francisco, 96346				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 52	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

ILLUSTRATED KEY TO THE FEMALE ANOPHELES MOSQUITOES OF THAILAND

Prepared by

MSG. E.L. Peyton

and

LTC. John E. Scanlon

Illustrations by

Mr. Vichai Malikul

and

Mr. Sorasak Imvitaya

**DEPARTMENT OF MEDICAL ENTOMOLOGY
U.S. ARMY MEDICAL COMPONENT
SOUTH EAST ASIA TREATY ORGANIZATION
APO SAN FRANCISCO 96346**

September 1966

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research.

2. The second part of the report is a detailed description of the methodology used in the study. It includes a discussion of the data collection methods and the statistical analysis techniques used.

3. The third part of the report is a discussion of the results of the study. It includes a comparison of the results with the objectives of the study and a discussion of the implications of the findings.

INTRODUCTION

Malaria has long been recognized as one of the primary public health problems in the Kingdom of Thailand. The Ministry of Public Health and other agencies of the governments of Thailand and the United States have cooperated in recent years in attempts to control or eradicate the disease. More recently, the problem has taken on added significance because of the detection of strains of the most dangerous malaria parasite, *Plasmodium falciparum*, which do not respond satisfactorily to the usual chemotherapeutic agents.

Basic studies on the mosquito fauna of Thailand were undertaken by the Department of Medical Entomology, United States Army Component—Southeast Asia Treaty Organization (SEATO) in 1961. At present, studies on the taxonomy, biology, distribution and disease relationships of the mosquitoes of the Kingdom are continuing with considerable emphasis on the malaria vectors of the genus *Anopheles*. As these studies progressed it became apparent that there was no single source to which entomologists, malariologists, and other public health workers could refer to for assistance in identifying female *Anopheles* mosquitoes captured in epidemiological studies. The earlier references did not adequately cover the species which we found in the country, and the newer publications on single species or species groups were too scattered to be useful. Thus, the present illustrated key grew out of a recognized need for a single reference source which would permit the identification of all of the *Anopheles* mosquitoes which we now recognize as occurring here.

The preparation of the present key is part of a cooperative effort between this Department, The Walter Reed Army Institute of Research and the Smithsonian Institution.* Related publications now in preparation include an annotated checklist of the *Anopheles* of Thailand, with notes on biology and distribution, and a full systematic treatment of the males, females and immature stages.

The key has been made as simple as possible, consistent with the need for accuracy in identification. The morphological nomenclature used follows that of Belkin (1962) with minor modifications. All of the structures named in the key are illustrated in the figures on Plates I thru XIX. The illustrations, which add immeasurably to the utility of the key, are based on actual specimens collected in Thailand or adjacent areas. In most cases the drawings were made from single specimens, but since key structures represent a composite of several specimens it was necessary in a few cases to fill in missing details from other specimens. In addition, for comparative purposes illustrations of wings of all but eight species have been included even though a specific reference in the key is not made to each wing. The wings have been drawn to scale from individual specimens and should not be interpreted as exact lengths for all specimens in a given population. Where morphological features of several species were found to be extremely similar (such as palps and proboscis of the *Anopheles barbirostris* and *hyrcanus* groups and wings of the *aikenii* group, etc.) only a single figure was prepared for the groups. Generalized drawings showing the location of important morphological features have also been included in figures 106—107 and 112.

Users of the key should recognize that not all of the specimens collected will fit precisely either the written couplets or the illustrations. Although several specimens of each species were studied before selecting key structures, the usual range of variation in nature and the close relationship of some of the species involved may make it impossible to identify a varying proportion of individuals without access to associated males or larval or pupal skins. We have tried to avoid this problem where possible

* Mosquitoes of Southeast Asia, Contract Number DA-49-193-MD-2672, between the Smithsonian Institution and the U.S. Army Medical Research and Development Command.

by providing several alternate criteria for identifying the difficult species. Where several alternates are presented it is usually an indication that the use of a single structure is not always conclusive and that all should be checked before a final determination is made. However, a key is of necessity an aid to identification and not a substitute for an adequate reference collection of identified specimens or a full written description of a species.

We have also tried to avoid the use of such ambiguous terms as "often" or "usually", but this is not always possible where one is dealing with variable, closely related species (such as members of the *barbirostris* and *hyrcanus* groups). Users of the key should attempt to submit specimens which cannot be placed with confidence in a particular couplet to a taxonomist for further study.

We believe that it may be useful for user of the key to have an indication of the groups of related species which are so similar as to cause difficulty in identification. The group names used are for convenience and are not intended to have particular taxonomic significance:

AITKENII GROUP — *bengalensis*, *fragilis*, *insulaeflorum*, and *palmatus*.

BARBIROSTRIS GROUP — *barbirostris*, *barbumbrosus*, *campestris*, *donaldi*, *hodgkini* and *pollicaris*.

HYRCANUS GROUP — *argyropus*, *crawfordi*, *indiensis*, *lesteri*, *nigerrimus*, *peditaeniatus*, *pursati* and *sinensis*.

LEUCOSPHYRUS GROUP — *balabacensis*, *balabacensis introlatus*, *hackeri*, *pujutensis* and *riparis macarthurii*.

MINIMUS GROUP — *aconitus*, *filipinae*, *minimus*, *pampanai* and *varuna*.

UMBROSUS GROUP — *baezai*, *letifer*, *roperi* and *umbrosus*.

CHECKLIST OF ANOPHELES TAXA RECORDED FROM THAILAND

Valid Records

- Anopheles* (*Anopheles*) *annandalei interruptus* Puri 1/1/61
A. (*Anopheles*) *argyropus* (Swellengrebel) 1/1/61
A. (*Anopheles*) *asiaticus* (Leicester) 1/1/61
A. (*Anopheles*) *baezai* Gater 1/1/61
A. (*Anopheles*) *barbirostris* Wulp 1/1/61
A. (*Anopheles*) *barbumbrosus* Strickland and Choudhury 1/1/61
A. (*Anopheles*) *bengalensis* Puri 1/1/61
A. (*Anopheles*) *bulkleyi* Causey 1/1/61
A. (*Anopheles*) *campestris* Reid 1/1/61
A. (*Anopheles*) *crawfordi* Reid 1/1/61
A. (*Anopheles*) *donaldi* Reid 1/1/61
A. (*Anopheles*) *fragilis* (Theobald) 1/1/61
A. (*Anopheles*) *hodgkini* Reid 1/1/61
A. (*Anopheles*) *indiensis* Theobald 1/1/61
A. (*Anopheles*) *insulaeflorum* (Swellengrebel and Swellengrebel) 1/1/61
A. (*Anopheles*) *lesteri paraliae* Sandosham 1/1/61
A. (*Anopheles*) *letifer* Sandosham 1/1/61
A. (*Anopheles*) *montanus* Stanton and Hacker 1/1/61
A. (*Anopheles*) *nigerrimus* Giles 1/1/61
A. (*Anopheles*) *palmatus* (Rodenwaldt) 1/1/61
A. (*Anopheles*) *peditaeniatus* (Leicester) 1/1/61
A. (*Anopheles*) *pollicaris* Reid 1/1/61
A. (*Anopheles*) *pursati* Laveran 1/1/61
A. (*Anopheles*) *roperi* Reid 1/1/61
A. (*Anopheles*) *separatus* Leicester 1/1/61
A. (*Anopheles*) *shensi* Wiedemann 1/1/61
A. (*Anopheles*) *sintonoides* Ho 1/1/61
A. (*Anopheles*) *umbrosus* (Theobald) 1/1/61
A. (*Cellia*) *aconitus* Donitz 1/1/61
A. (*Cellia*) *annularis* Wulp 1/1/61
A. (*Cellia*) *balabacensis* Baisas 1/1/61
A. (*Cellia*) *balabacensis introlatus* Colless 1/1/61
A. (*Cellia*) *culicifacies* Giles 1/1/61
A. (*Cellia*) *hackeri* Edwards 1/1/61
A. (*Cellia*) *jamesii* Theobald 1/1/61
A. (*Cellia*) *jeyporiensis candidiensis* Koizumi 1/1/61
A. (*Cellia*) *karwari* (James) 1/1/61
A. (*Cellia*) *kochi* Donitz 1/1/61
A. (*Cellia*) *maculatus* Theobald 1/1/61
A. (*Cellia*) *minimus* Theobald 1/1/61
A. (*Cellia*) *pallidus* Theobald 1/1/61
A. (*Cellia*) *pampanai* Buttiker and Beales 1/1/61
A. (*Cellia*) *philippinensis* Ludlow 1/1/61
A. (*Cellia*) *pujutensis* Colless 1/1/61

- A. (*Cellia*) *ramsayi* Covell ~~113~~ 18
- A. (*Cellia*) *riparis macarthuri* Colless ~~113~~ 19
- A. (*Cellia*) *splendidus* Koizumi ~~113~~ 20
- A. (*Cellia*) *stephensi* Liston ~~113~~ 21
- A. (*Cellia*) *subpictus* Grassi ~~113~~ 22
- A. (*Cellia*) *sundaicus* (Rodenwaldt) ~~113~~ 23
- A. (*Cellia*) *tessellatus* Theobald ~~113~~ 24
- A. (*Cellia*) *vagus* Donitz ~~113~~ 25

Doubtful Records

- Anopheles* (*Anopheles*) *aikenii* James ~~113~~ 26
- A. (*Anopheles*) *albotaeniatus* (Theobald) ~~113~~ 27
- A. (*Anopheles*) *gigas formosus* Ludlow ~~113~~ 28
- A. (*Anopheles*) *gigas sumatrana* Swellengrebel and Rodenwaldt ~~113~~ 29
- A. (*Cellia*) *filipinae* Manalang* ~~113~~ 30
- A. (*Cellia*) *fluvialis* James* ~~113~~ 31
- A. (*Cellia*) *maculatus willmori* James ~~113~~ 32
- A. (*Cellia*) *majidi* Young and Majid ~~113~~ 33
- A. (*Cellia*) *varuna* Iyengar* ~~113~~ 34

Misidentifications

- Anopheles* (*Cellia*) *jeyporiensis* James

* Tentatively included in the key pending further investigation.

KEY TO THE FEMALE ANOPHELES MOSQUITOES OF THAILAND¹

1. Wings with contrasting pale and dark scales (figs. 2-3 and 5-47)	3
Wings uniformly dark, without pale scales (ANOPHELES) (fig. 1)	2
2. Head scales long and narrow, only slightly expanded apically (fig. 4, a)	<i>bengalensis</i> ² <i>insulaeflorum</i> <i>palmaris</i> <i>fragilis</i>
Head scales broad and of normal length (fig. 4, b)	<i>sintonoides</i>
3. Wings with less than four dark areas involving both veins C and R-R ₁ (ANOPHELES) (figs. 2-3 and 5-24)	4
Wings with at least four dark areas involving both veins C and R-R ₁ (CELLIA) (figs. 25-47)	25
4. Hind femur with a prominent tuft of black and white scales at apex (fig. 70)	5
Hind femur without a tuft of black and white scales at apex (figs. 71-92)	6
5. Palpus with three pale bands (fig. 50). Wing with fringe spot at vein R ₄₊₅ (fig. 2)	<i>annandalei interruptus</i>
Palpus unbanded, or with a few pale scales at joint of segments 3-4 (fig. 51). Wing without fringe spot at vein R ₄₊₅ (fig. 3)	<i>asiaticus</i>
6. Palpus without pale bands (fig. 52)	7
Palpus with pale bands (figs. 53-54)	17
7. Abdomen with a ventral tuft of dark scales on segment VII (fig. 108)	8
Abdomen without a ventral tuft of dark scales on segment VII	13
8. Fringe spot at wing vein R ₄₊₅ wide, extending back to vein M ₁₊₂ (fig. 5). Sternites without pale scales	<i>barbumbrosus</i>
Fringe spot at wing vein R ₄₊₅ narrow, not reaching vein M ₁₊₂ (figs. 6-10). Sternites with at least a few median pale scales (figs. 102-105)	9
9. Wing with only two apical fringe spots, none at vein R ₂ (figs. 6-7). Mid tarsi often unbanded (fig. 71)	10

¹ *Anopheles bulkleyi* Causey, known only from the male, is not included in the key.

² Females of this species group are not separable at present. Identification depends on the male genitalia and immature stages.

- Wing with three apical fringe spots, the middle one at vein R_2 (figs. 8-10). Mid tarsi usually with narrow pale bands (fig. 72) 11
10. Wing darker, usually more than half the scales dark between the basal dark mark on vein Cu and the apical dark mark on vein Cu_2 (fig. 7). Sternites with numerous pale scales, several scattered diagonally between the median tufts and a row of scales on the lateral margins (fig. 102) *campestris*
- Wing paler, usually less than half the scales dark between the basal dark mark on vein Cu and the apical dark mark on vein Cu_2 (fig. 6). Sternites with few pale scales, confined almost entirely to the median tufts and a few on the lateral sternal margins (fig. 103) *barbirostris*
11. Fore tarsi with broad pale bands, band at junction of tarsomeres 1-2 longer than tarsomere 5, about one third of the band on base of tarsomere 2 (fig. 73). Pale scales sometimes present on costa between the subcostal and preapical pale spots (fig. 8) *pollicaris*
- Fore tarsi with narrow pale bands, band at junction of tarsomeres 1-2 seldom longer than tarsomere 5, one fourth or less of the band on base of tarsomere 2 (figs. 74-75). Pale scales absent between subcostal and preapical pale spots (figs. 9-10) 12
12. Pale band at junction of fore tarsomeres 1-2 more than half as long as tarsomere 5, usually crossing on to base of tarsomere 2 (fig. 74). Median white scales on abdominal sternites II-VI prominent, numbering from 20-50, often one or two pale scales on lateral sternal margins (fig. 104) *donaldi*
- Pale band at junction of fore tarsomeres 1-2 half or less as long as tarsomere 5, seldom crossing on to base of tarsomere 2 (fig. 75). Median white scales on abdominal sternites II-VI less prominent, usually numbering less than 20, none on the lateral sternal margins (fig. 105) *hodgkini*
13. Hind tarsomere 5 entirely white (fig. 76) *montanus*
Hind tarsomere 5 not entirely white (figs. 77-79) 14
14. Hind tarsi entirely dark or with minute pale bands rarely as long as wide (fig. 77) *baezai*
Hind tarsi with distinct pale bands longer than wide (figs. 78-79) 15
15. Propleural setae present (fig. 112) *umbrosus*
Propleural setae absent 16
16. Wing with three apical fringe spots; pale scales present on the extreme base of vein Cu and base of vein R, the remigium and usually on the base of costa (fig. 14). Base of hind tibia with a pale band (fig. 78) *roperi*
- Wing with only two apical fringe spots; no pale scales present on the base of either vein Cu, vein R, the remigium or costa (fig. 15). Base of hind tibia without a pale band (fig. 79) *letifer*

17. Abdomen with a ventral tuft of dark scales on segment VII (fig. 108). A lateral tuft of dark scales on clypeus towards base (fig. 53) 18

Abdomen without a ventral tuft of dark scales on segment VII. Clypeus without a lateral tuft of dark scales (fig. 54) *separatus*
18. Hind tarsi with narrow pale bands, tarsomere 4 without a basal pale band (fig. 80) 22

Hind tarsi with moderately broad to very broad pale bands, tarsomere 4 with a basal pale band (figs. 81, 83 and 85) 19
19. Dark band on hind tarsomere 4 narrow, basal pale band on hind tarsomere 5 involving half or more of segment (fig. 81) *argyropus*

Dark band on hind tarsomere 4 broad, basal pale band on hind tarsomere 5 involving one third or less of segment (figs. 83 and 85) 20
20. Wing pattern bright, the dark marks mostly short and well defined, dark mark on vein R_s well defined, scales between the dark mark and fork predominantly white, basal dark mark on vein Cu short, separated by its own length or more from the upper mark on vein 1A (fig. 20) *indiensis*

Wing pattern darker, more or less blurred, dark mark on vein R_s poorly defined, diffused, scales between the dark mark and fork predominantly dark or dull yellowish brown, basal dark mark on vein Cu long, approaching to within its own length or less of the upper mark on vein 1A (figs. 18-19) 21
21. Pale bands on fore and hind tarsi very broad, apical band on fore tarsomere 2 (fig. 82) and band at junction of hind tarsomeres 3-4 (fig. 83) as long as or longer than the corresponding tarsomere 5. Posterolateral angles of abdominal tergite VIII usually without narrow scales. Basal half of costa without pale scales (fig. 18) *peditaeniatus*

Pale bands on fore and hind tarsi moderately broad, apical band on fore tarsomere 2 (fig. 84) and band at junction of hind tarsomeres 3-4 (fig. 85) seldom as long as the corresponding tarsomere 5. Posterolateral angles of abdominal tergite VIII usually with a few narrow scales. Basal half of costa often with a few scattered pale scales (fig. 19) *nigerrimus*
22. Wing with very short fringe spot between veins R_1 and R_3 (figs. 21-22) 23

Wing with apical fringe spot broad, extending at least from veins R_2 to R_{4+5} (figs. 23-24) 24
23. Basal dark mark on wing vein Cu long, approaching to within its own length or less of the upper dark mark on vein 1A. Humeral cross vein bare (fig. 21). Pale scales on mid coxae usually absent *lesteri paraliae*

Basal dark mark on wing vein Cu short, separated by its own length or more from the upper mark on vein 1A. Humeral cross vein with dark scales (fig. 22). Mid coxae with some white scales (fig. 112) *pursati*

24. Wing pattern bright, the dark marks short and well defined. Tip of vein R_1 pale; apical fringe spot rather short commencing at vein R_2 , no fringe spot at vein Cu_2 , apical dark mark on vein 1A not longer than that on vein Cu_2 , no pale scales on vein R_1 between subcostal and preapical pale spots (fig. 23) *crawfordi*
- Wing pattern blurred. Tip of vein R_1 dark, apical fringe spot longer, commencing at or above vein R_2 , fringe spot usually present at vein Cu_2 , apical dark mark on vein 1A longer than that on vein Cu_2 , some pale scales on vein R_1 between subcostal and preapical pale spots (fig. 24) *sinensis*
25. Femur, tibia and tarsomere 1 speckled with patches of pale scales (figs. 86-92) 26
- Femur, tibia and tarsomere 1 without patches of pale scales (figs. 93-101) 38
26. Hind tarsomeres 3, 4 and 5 entirely pale (figs. 86-87) 27
- Hind tarsomeres 3, 4 and 5 not entirely pale (figs. 88-92) 29
27. Palpus with pale spots on segments 2 and 3, subapical pale band broad, approximately equal to apical band (fig. 55) *splendidus*
- Palpus without pale spots on segments 2 and 3, subapical pale band narrow, less than half the length of apical band (fig. 56) 28
28. Golden scales on abdominal terga VI-VIII (fig. 110). Apex of hind tarsomere 1 without a distinct pale band (fig. 86) *jamesii*
- No golden scales on abdominal terga VI-VIII (fig. 111). Apex of hind tarsomere 1 with a distinct pale band (fig. 87) *ramsayi*
29. Hind tarsomere 5 entirely pale (fig. 88) *maculatus*
- Hind tarsomere 5 not entirely pale (figs. 89-92) 30
30. Tibio-tarsal joint of hind leg with large conspicuous white band (fig. 89) 31
- Tibio-tarsal joint of hind leg without large white band (figs. 91-92) 35
31. Basal dark spot on wing vein R with one or more pale interruptions on at least one wing (fig. 29) 32
- Basal dark spot on wing vein R without pale interruptions (fig. 30) 33
32. Hind tarsomere 4 with a distinct basal pale band (fig. 89) *balabacensis*

- Hind tarsomere 4 without a basal pale band (fig. 90) *balabacensis introlatus*
33. Palpus noticeably shorter than proboscis. Proboscis with a narrow pale band at apex, proximal to the labella (figs. 57-58) 34
- Palpus not noticeably shorter than proboscis. Proboscis without pale band (fig. 59) *riparis macarthuri*
34. Palpus with very narrow pale bands, apical segment merely tipped with pale scales (fig. 58) *hackeri*
- Palpus with broader pale bands, the apical band about as broad as preapical dark band (fig. 57) *pajutensis*
35. Apical half of proboscis pale. Palpus with at least four pale bands (fig. 60) 36
- Apical half of proboscis dark. Palpus with only three pale bands (figs. 61-62) 37
36. Abdominal sternites with conspicuous median tufts of dark scales (fig. 109). Hind tarsi with broad pale bands (fig. 91) *kochi*
- Abdominal sternites without scale tufts. Hind tarsi with narrow pale bands (fig. 92) *tessellatus*
37. Palpus with two broad apical pale bands, segment 2 with pale spots dorsally (fig. 61) *stephensi*
- Palpus with only one broad apical pale band, segment 2 without pale spots (fig. 62) *sundaicus*
38. Hind tarsomeres 3, 4 and 5 all white (figs. 94-95) 39
- Hind tarsomeres 3, 4 and 5 not all white (figs. 98-101) 41
39. Wing veins Cu and Cu₂ mostly dark scaled, an area of dark scales at origin of vein Cu₁ (fig. 35) *annularis*
- Wing veins Cu and Cu₂ mostly pale, without dark scales at origin of vein Cu₁ (figs. 36-37) 40
40. Abdomen with few or no pale scales except apically on venter and dorsum. Apex of hind tarsomere 1 usually with a narrow pale band (fig. 94) *philippinensis*
- Abdomen with scattered pale scales on most segments ventrally and on five or six segments dorsally. Apex of hind tarsomere 1 never with a pale band (fig. 95) *pallidus*
41. Hind tarsi with broad pale bands, tarsomere 5 entirely pale (fig. 93). Palpus with four pale bands (fig. 63) *karwari*

	Hind tarsi without broad pale bands, tarsomere 5 not entirely pale (figs. 98-101). Palpus with three pale bands (figs. 64-69)	42
42.	Fore tarsi with broad pale bands (fig. 96), mid and hind tarsi with narrow pale bands slightly wider than diameter of tarsomeres (fig. 98)	43
	Fore tarsi without broad pale bands (fig. 97). If pale banding is present on any of tarsomeres, it is usually very narrow and not wider than the diameter of tarsomeres (figs. 99-101)	44
43.	Palpus with apical pale band three to four times the length of the preapical dark band (fig. 64)	<i>vagus</i>
	Palpus with apical pale band about two times or less the length of the preapical dark band (fig. 65)	<i>subpictus</i>
44.	Mesonotum heavily covered with white hair-like scales (fig. 48). Tarsi with narrow pale bands approximately as long as tarsomere diameter (fig. 99)	<i>jeyporiensis candidiensis</i>
	Mesonotum without scales, lightly covered with setae (fig. 49). Tarsi entirely dark or with very minute pale bands (figs. 100-101)	45
45.	Palpus with two broad apical pale bands, the preapical dark band narrow (sometimes indistinct), no wider than the pale apical bands (figs. 68-69)	46
	Palpus with narrow pale bands or only the apical pale band broad, the preapical dark band very broad, much wider than either of the two apical pale bands (figs. 66-67)	50
46.	Wing usually without a fringe spot at vein 1A (figs. 41-43)	47
	Wing usually with a fringe spot at vein 1A (figs. 44-45)	49
47.	Basal third of costa entirely dark (fig. 41)	<i>varuna</i>
	Basal third of costa with one or more pale interruptions on at least one wing (figs. 42-43)	48
48.	Basal third of costa with two pale interruptions (fig. 42). Legs with minute apical pale bands on most tarsomeres (fig. 100)	<i>pampanai</i>
	Basal third of costa with one pale interruption (fig. 43). Tarsomeres entirely dark (fig. 101)	<i>minimus</i>
49.	Apical half of proboscis pale (fig. 68)	<i>aconitus</i>
	Apical half of proboscis dark (fig. 69)	<i>filipinae</i>
50.	Wing vein R ₄₊₅ dark for nearly entire length, small pale spot near origin, base of vein R with dark spot (fig. 46)	<i>culicifacies</i>
	Wing vein R ₄₊₅ with long pale area in middle, base of vein R pale (fig. 47)	<i>fluviatilis</i>

BIBLIOGRAPHY

The following bibliography is presented as an aid to those who may wish to consult additional reference material on the *Anopheles* of Thailand. No claim is made to completeness, but the majority of recent publications containing records of Thailand *Anopheles* are included. The works of Christophers (1933) and Bonne—Wepster and Swellengrebel (1953) are particularly useful, since they contain descriptions of many of the species in the Thai fauna. However, neither of these works is readily available at present.

- Belkin, J.N. 1962. The mosquitoes of the South Pacific. University of Calif. Press, Berkeley and Los Angeles, Vol. I, 608 pp. and Vol. II, 412 pp.
- Bonne—Wepster, J. and N.H. Swellengrebel. 1953. The Anopheline mosquitoes of the Indo—Australian region. de Bussey, Amsterdam. 504 pp.
- Buttiker, W. and P. Beales. 1959. *Anopheles pampanae*, a new species of mosquito from Cambodia. Acta Tropica 16(1): 63—69.
- Causey, O.R. 1937. New anopheline and culicine mosquitoes from Siam. Jour. Parasitol. 23(5): 543—545.
- Christophers, S.R. 1933. The fauna of British India. Diptera. Vol. IV. Anophelini. Taylor and Francis, London. 371 pp.
- Colless, D.H. 1956. The *Anopheles leucosphyrus* group. Trans. Roy. Ent. Soc. London. 108(3): 37—116.
- Colless, D.H. 1957. Further notes on the systematics of the *Anopheles leucosphyrus* group (Diptera: Culicidae). Proc. Roy. Ent. Soc. London. 26(7—8): 131—139.
- Reid, J.A. 1950. The *Anopheles umbrosus* group (Diptera: Culicidae). Part I. Systematics, with descriptions of two new species. Trans. Roy. Ent. Soc. London. 101(9): 281—318.
- Reid, J.A. 1953. The *Anopheles hyrcanus* group in South—east Asia (Diptera: Culicidae). Bull. Ent. Res. 44(1): 5—76.
- Reid, J.A. 1962. The *Anopheles barbirostris* group (Diptera: Culicidae). Bull. Ent. Res. 53(1): 1—57.
- Reid, J.A. 1963. Notes on anopheline mosquitoes from Malaya, with descriptions of three new species. Ann. Trop. Med. Parasitol. 57(1): 97—116.
- Reid, J.A. 1965. A revision of the *Anopheles aikenii* group in Malaya and Borneo. Ann. Trop. Med. Parasitol. 59(1): 106—125.

PLATE I.

Wings and head scales.

- Fig. 1. *A. (Anopheles) insulaeflorum*, and other related forms.
2. *A. (Anopheles) annandalei interruptus*.
3. *A. (Anopheles) asiaticus*.
4. a. *A. (Anopheles) bengalensis*, and other members of *aitkenii* group.
b. *A. (Anopheles) sintonoides*.

PLATE I.

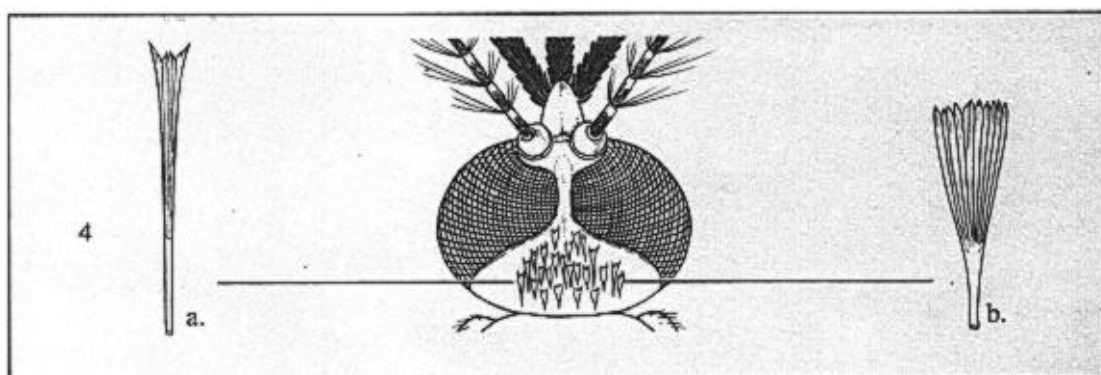
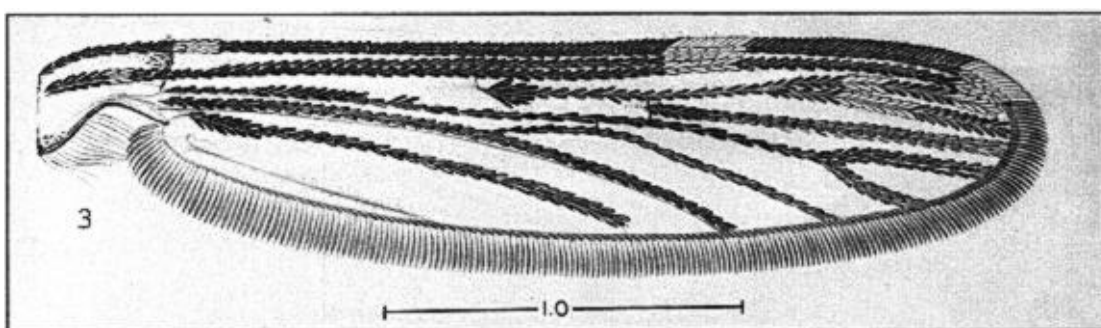
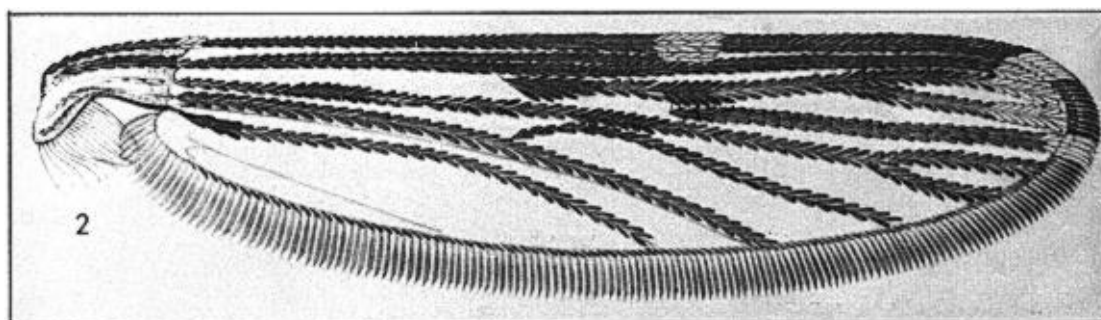
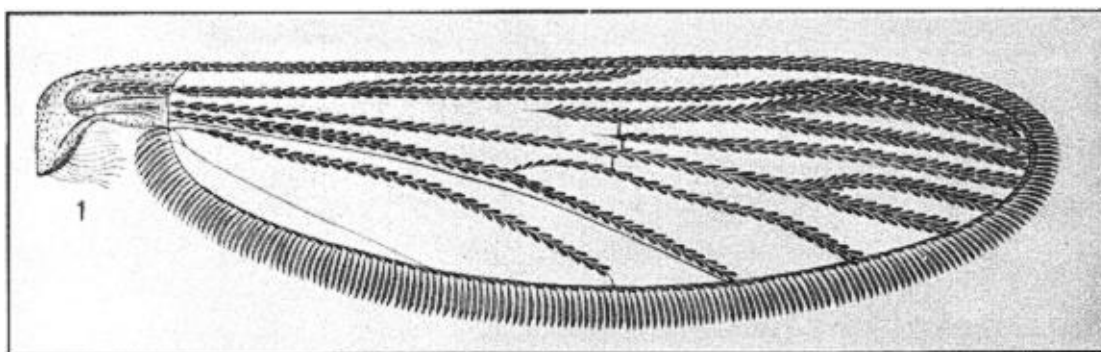


PLATE II.

Wings.

- Fig. 5. *A. (Anopheles) barbumbrosus*.
6. *A. (Anopheles) barbirostris*.
7. *A. (Anopheles) campestris*.
8. *A. (Anopheles) pollicaris*, (with costal variation).

PLATE II.

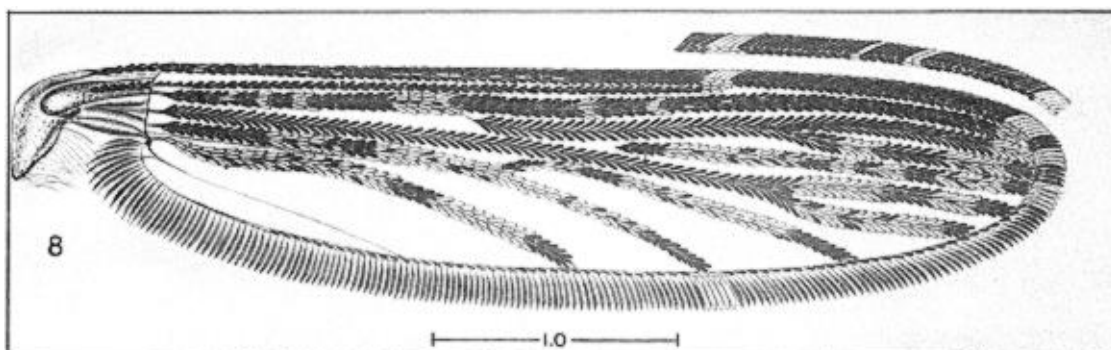
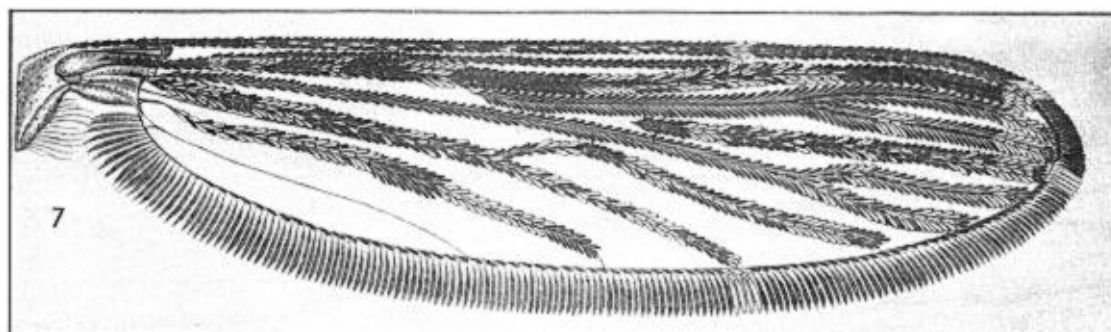
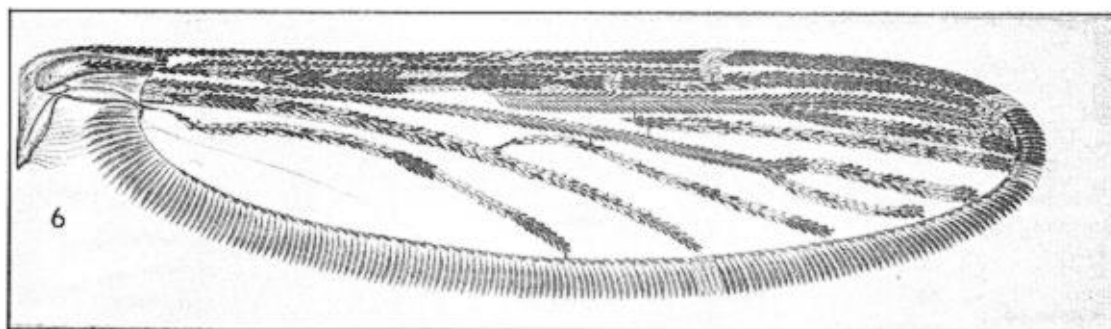
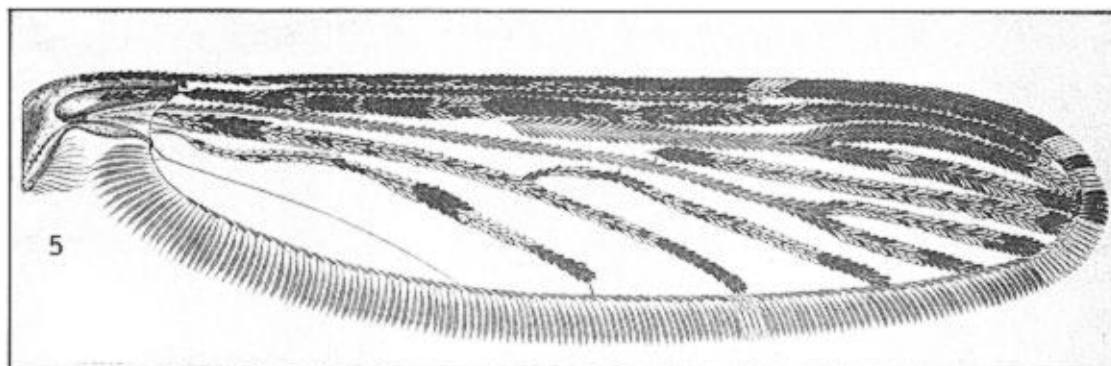


PLATE III.

Wings.

- Fig. 9. *A. (Anopheles) donaldi*.
10. *A. (Anopheles) hodgkini*.
11. *A. (Anopheles) montanus*.
12. *A. (Anopheles) baezai*.

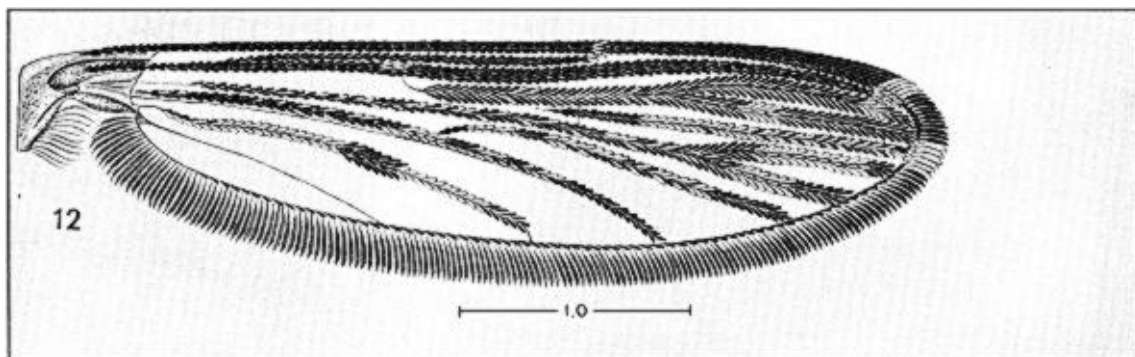
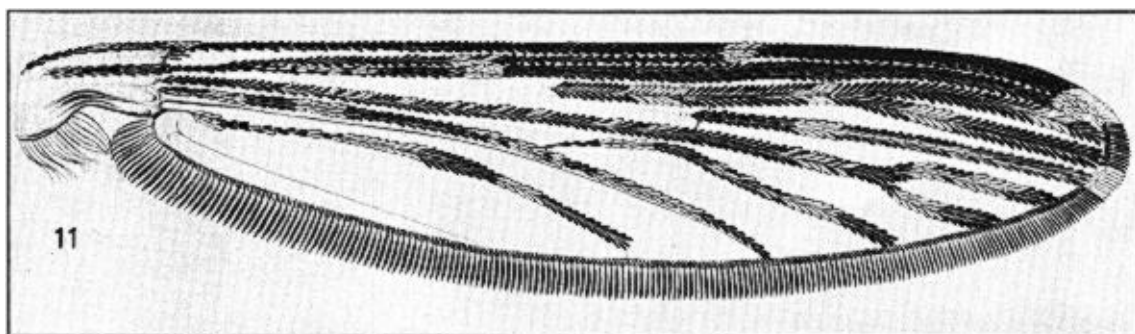
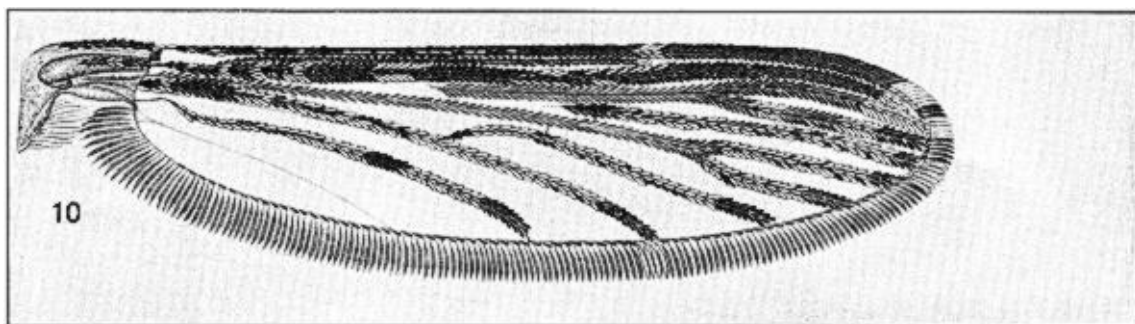
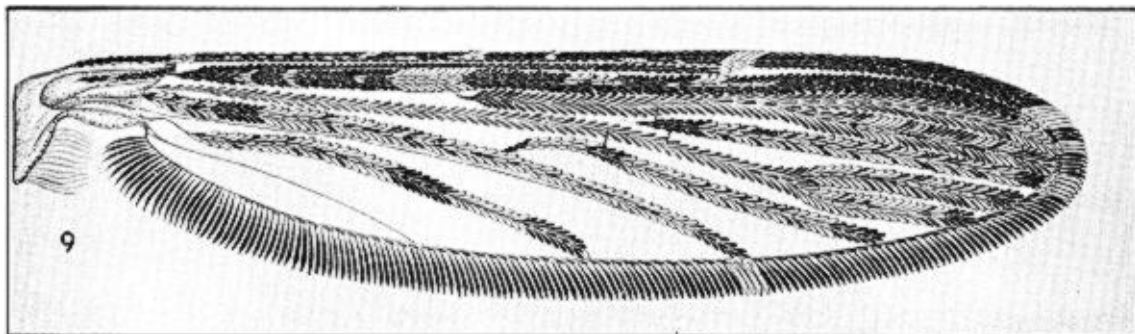


PLATE IV.

Wings.

- Fig. 13. *A. (Anopheles) umbrosus*.
14. *A. (Anopheles) roperi*.
15. *A. (Anopheles) letifer*.
16. *A. (Anopheles) separatus*.

PLATE IV.

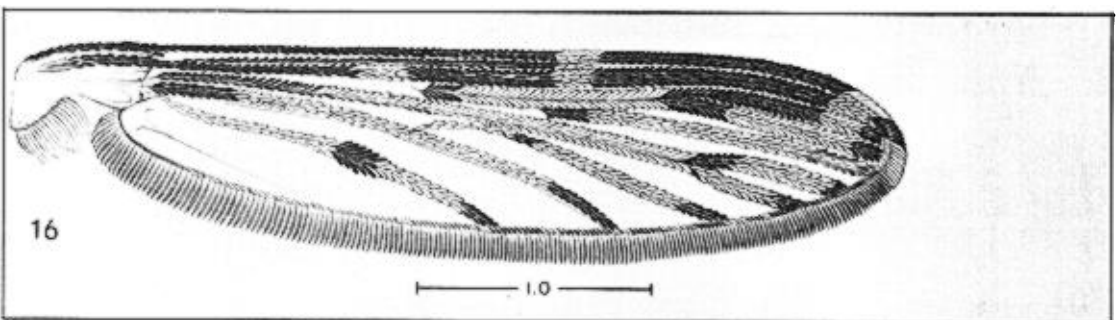
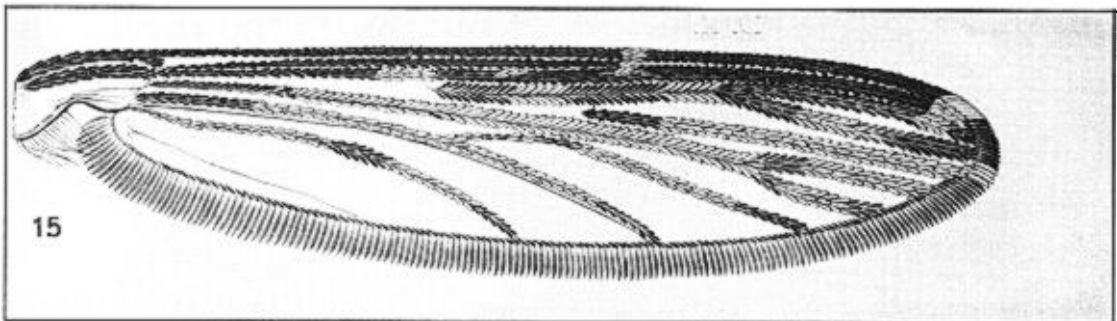
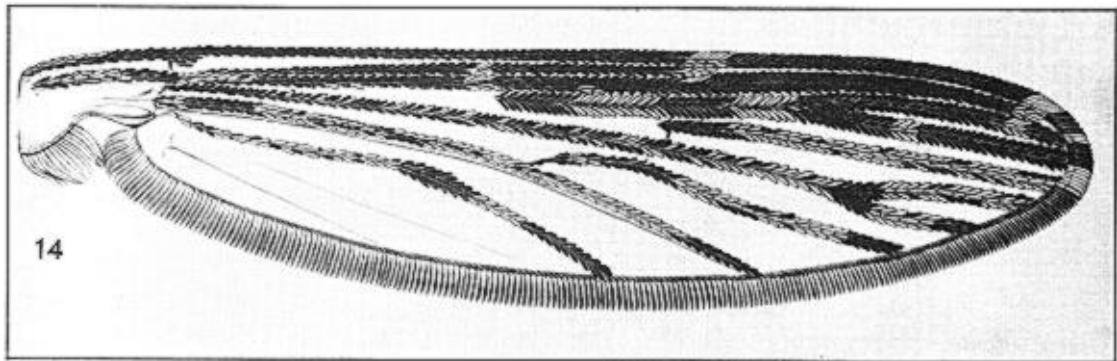
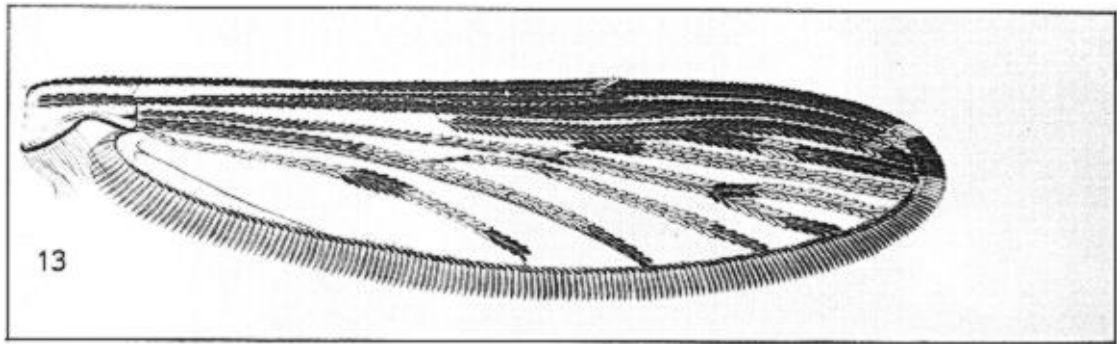


PLATE V.

Wings.

- Fig. 17. *A. (Anopheles) argyropus*.
18. *A. (Anopheles) peditaeniatus*.
19. *A. (Anopheles) nigerrimus*.
20. *A. (Anopheles) indiensis*.

PLATE V.

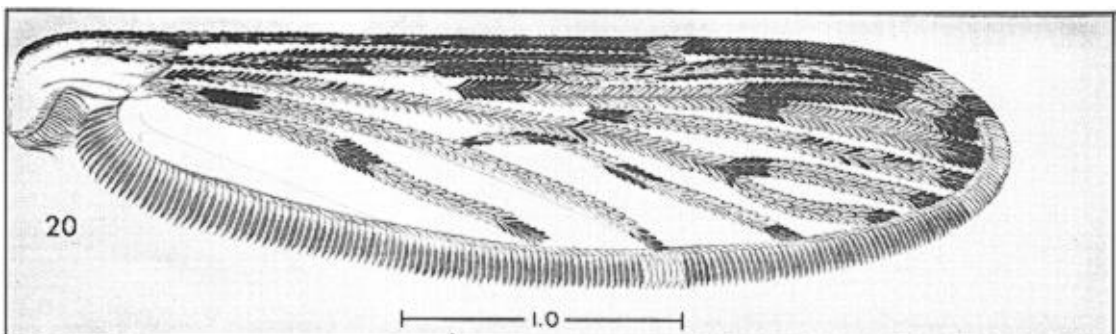
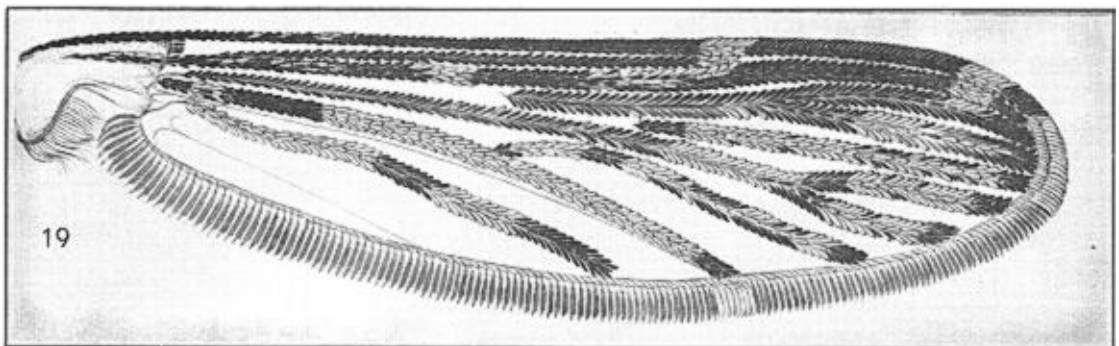
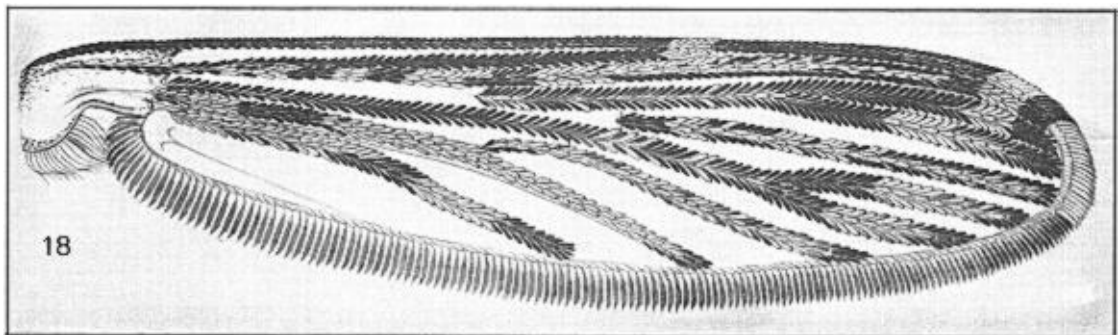
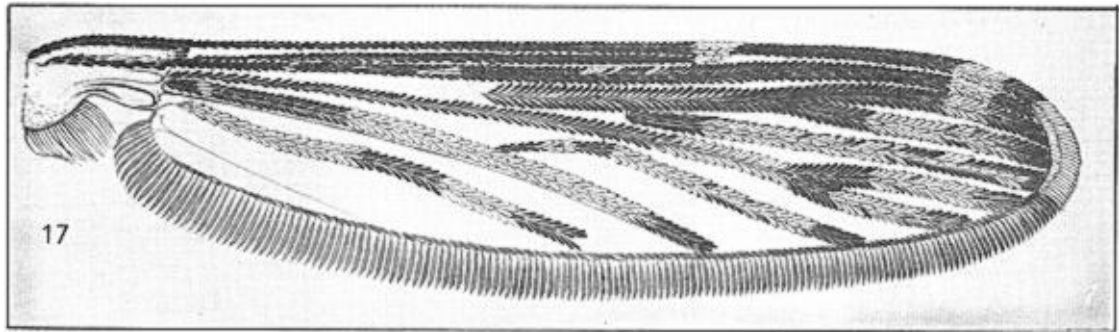


PLATE VI.

Wings.

- Fig. 21. *A. (Anopheles) lesteri*.
22. *A. (Anopheles) pursati*.
23. *A. (Anopheles) crawfordi*.
24. *A. (Anopheles) sinensis*.

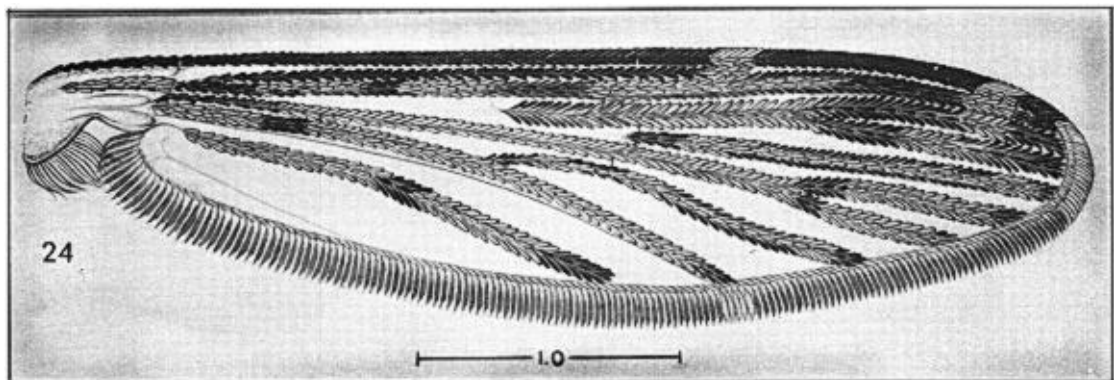
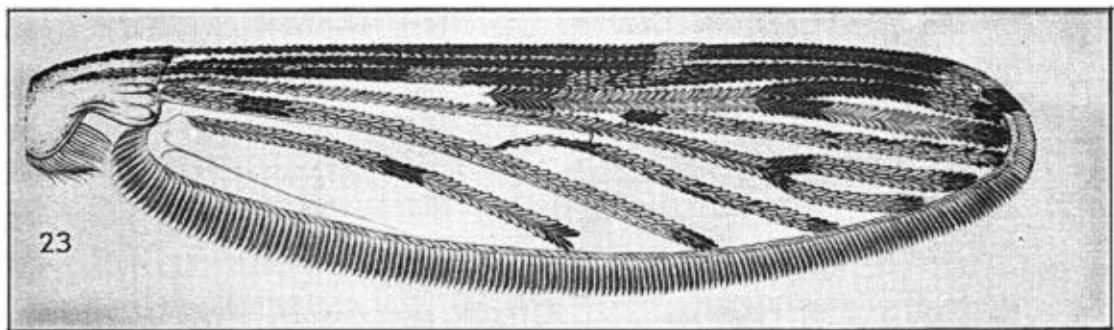
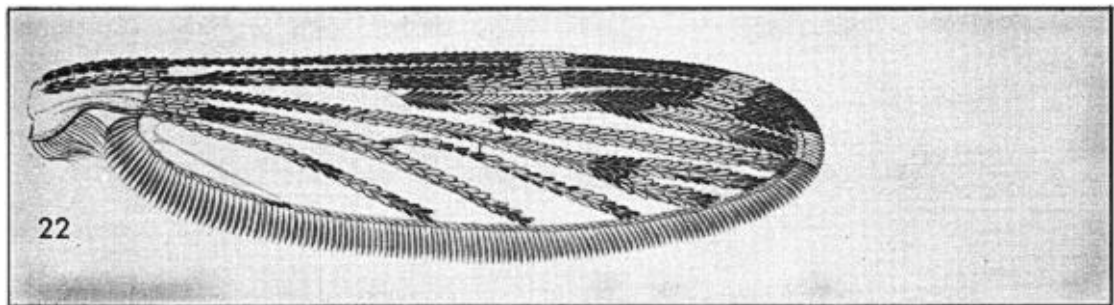
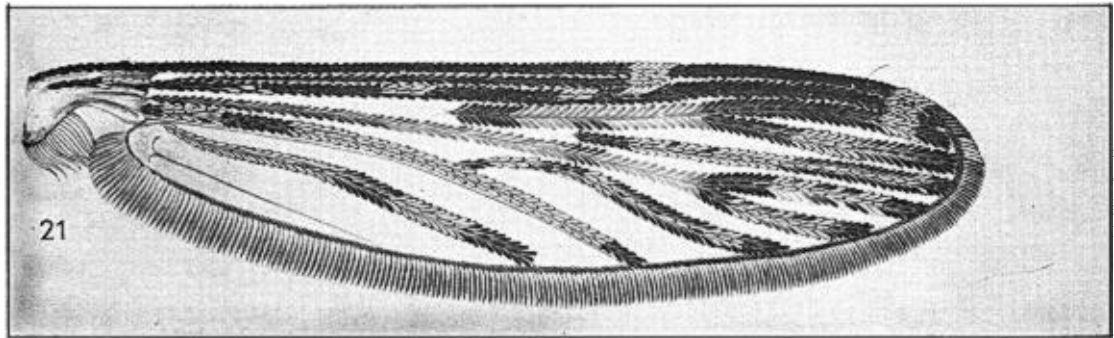


PLATE VII..

Wings.

- Fig. 25. *A. (Cellia) maculatus*.
26. *A. (Cellia) splendidus*.
27. *A. (Cellia) ramsayi*.
28. *A. (Cellia) jamesii*.

PLATE VII.

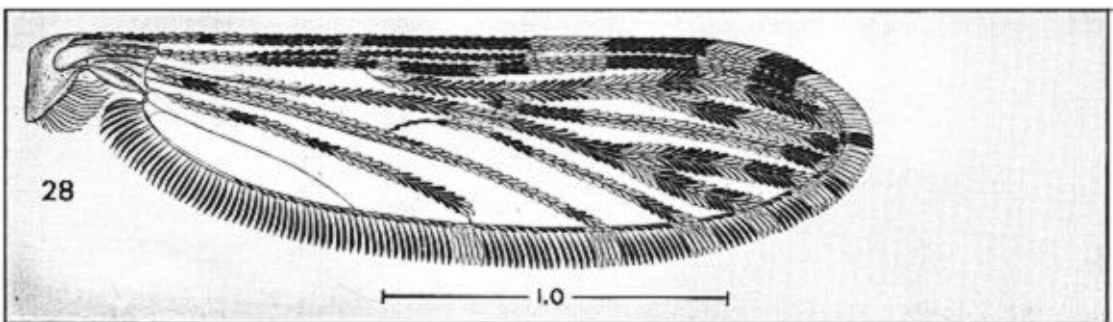
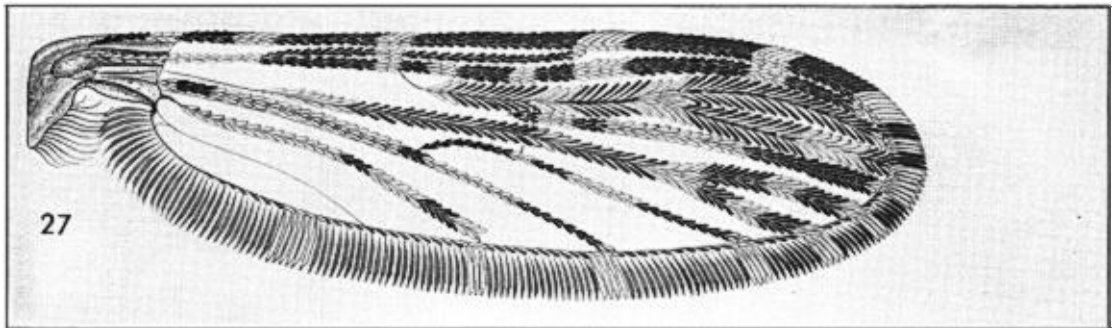
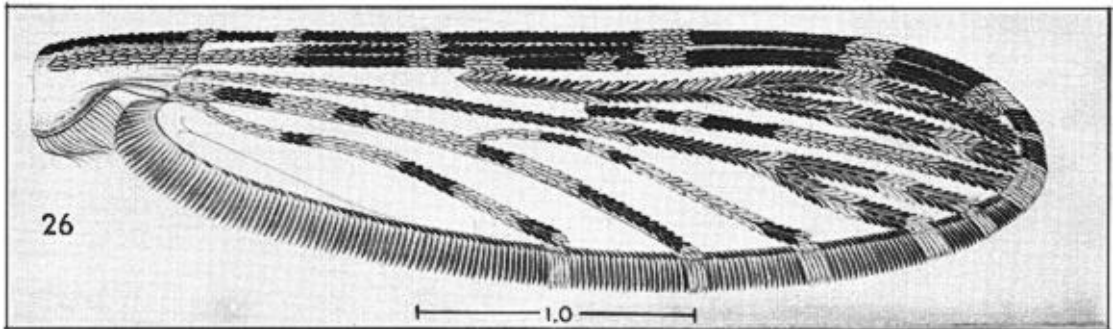
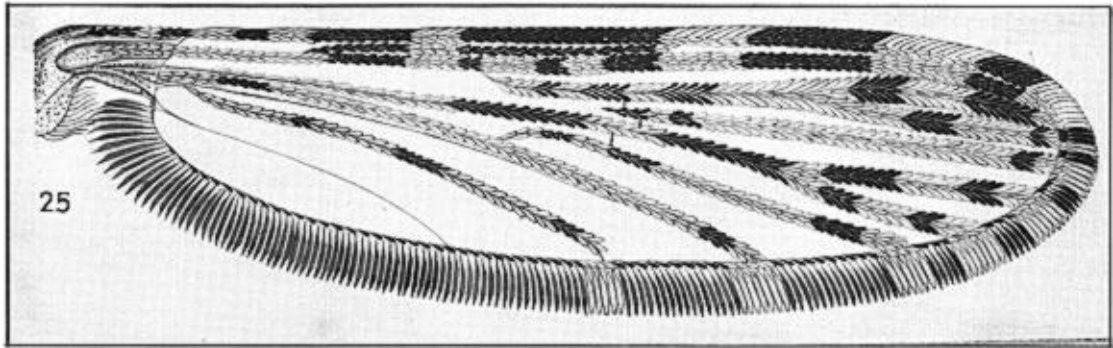


PLATE VIII.

Wings.

- Fig. 29. *A. (Cellia) balabacensis*, and other related forms.
30. *A. (Cellia) riparis macarthuri*, and other related forms.
31. *A. (Cellia) kochi*.
32. *A. (Cellia) tessellatus*.

PLATE VIII.

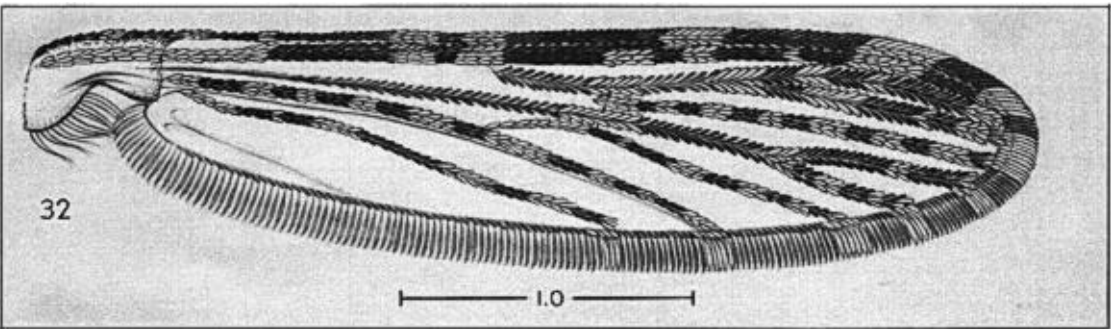
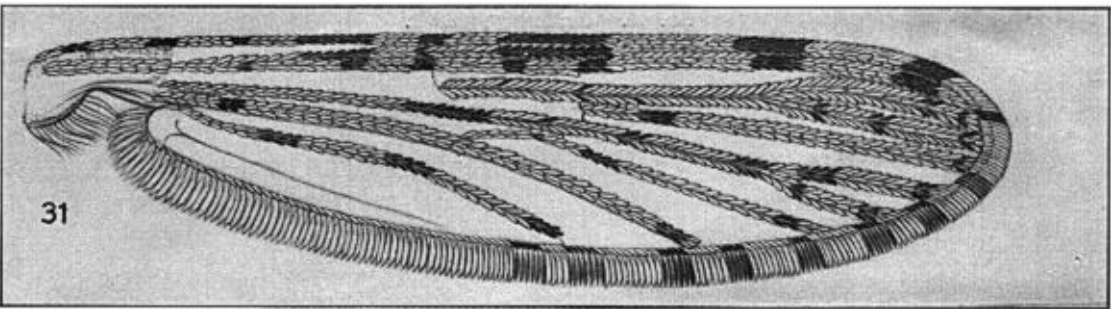
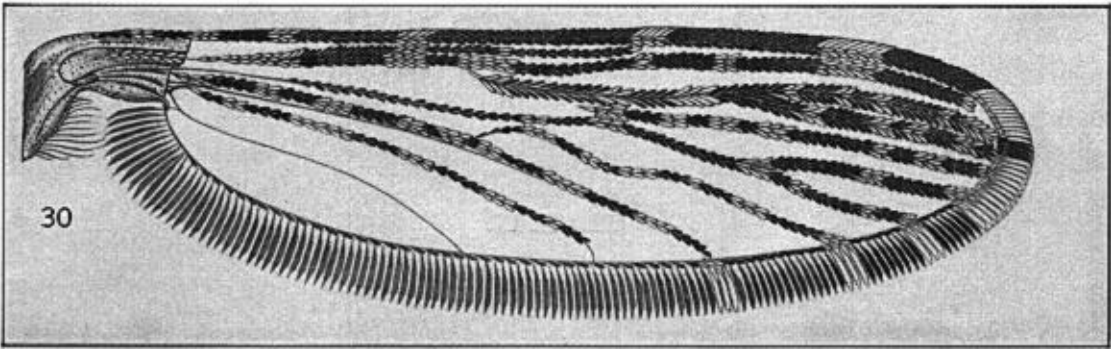
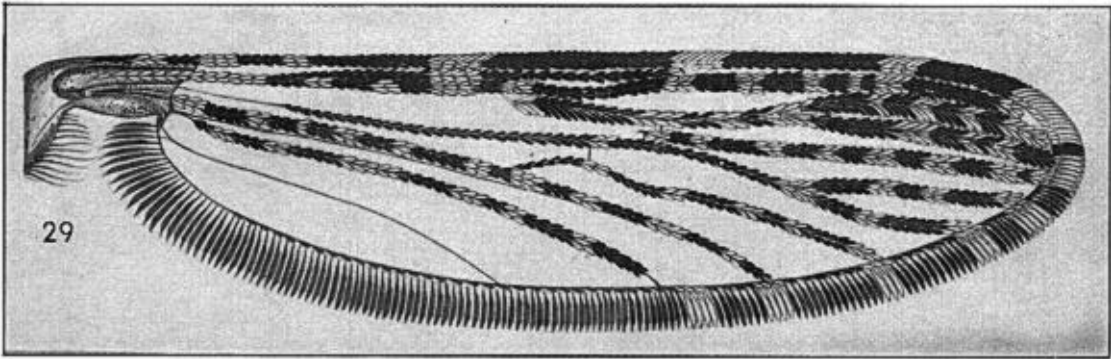


PLATE IX.

Wings.

- Fig. 33. *A. (Cellia) stephensi*.
34. *A. (Cellia) sundaicus*.
35. *A. (Cellia) annularis*.
36. *A. (Cellia) philippinensis*.

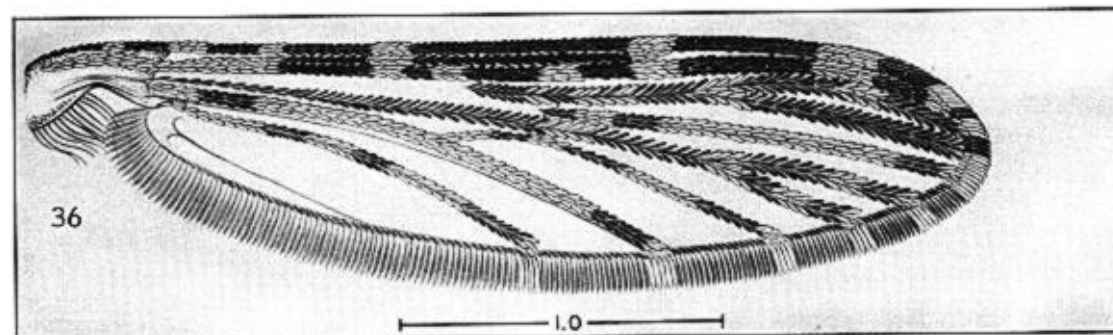
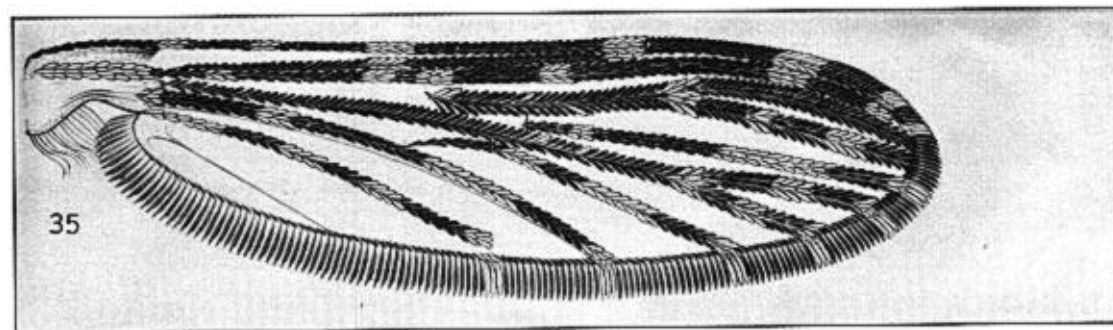
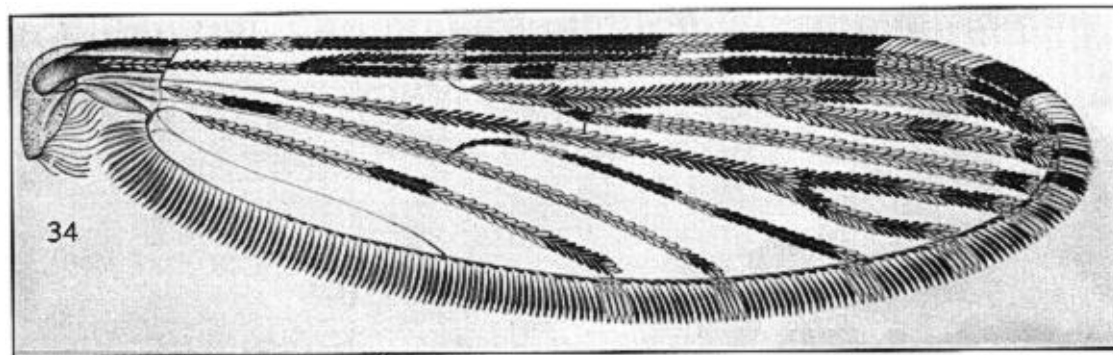
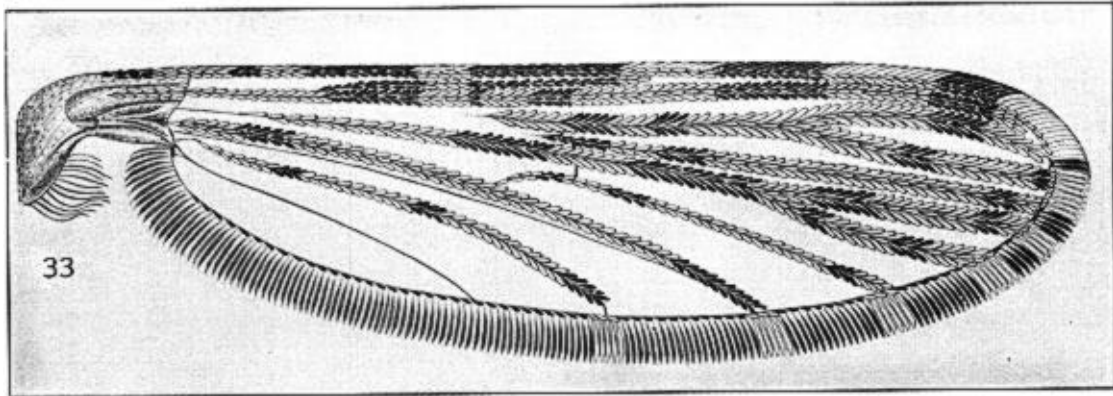


PLATE X.

Wings.

- Fig. 37. *A. (Cellia) pallidus*.
38. *A. (Cellia) karwari*.
39. *A. (Cellia) jeyporiensis candidiensis*.
40. *A. (Cellia) vagus*, and the closely related form. *subpictus*.

PLATE X.

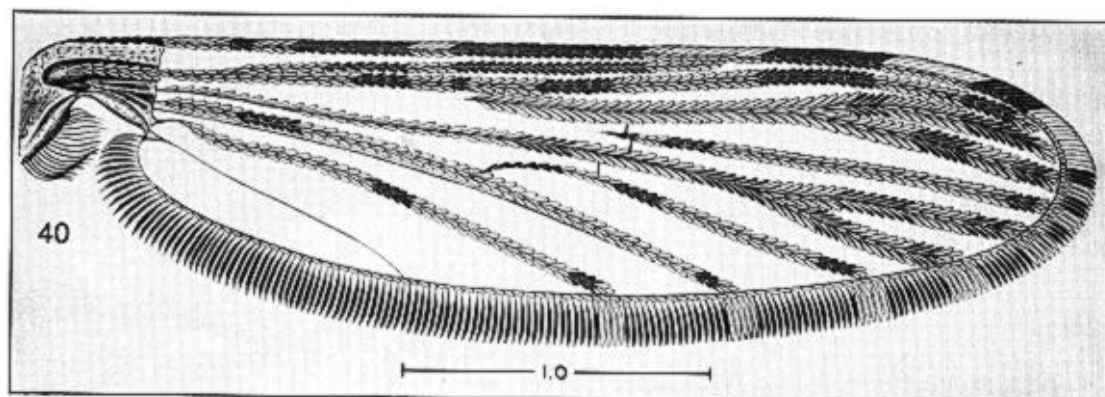
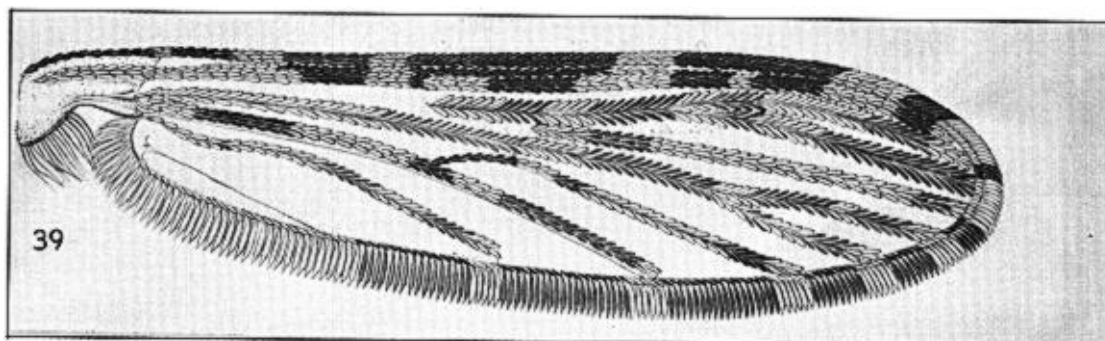
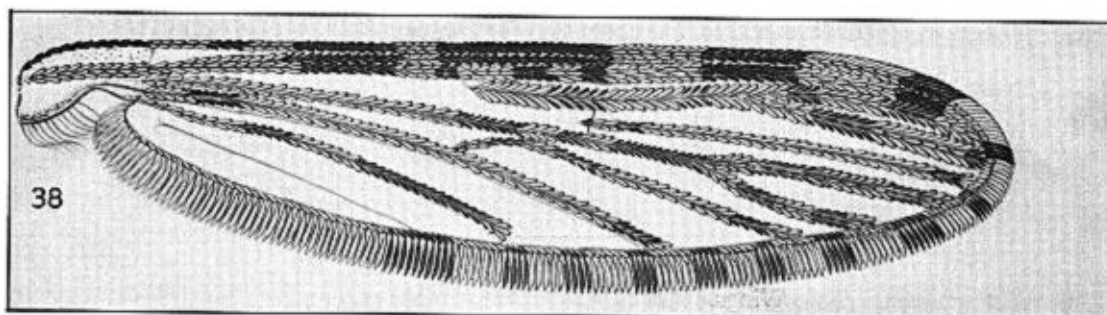
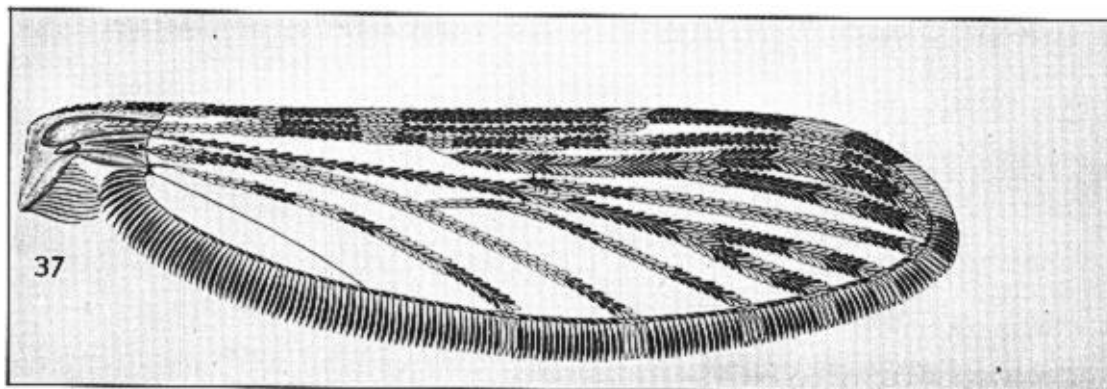


PLATE XI.

Wings.

- Fig. 41. *A. (Cellia) varuna*.
42. *A. (Cellia) pampanai*.
43. *A. (Cellia) minimus*.
44. *A. (Cellia) aconitus*.

PLATE XI.

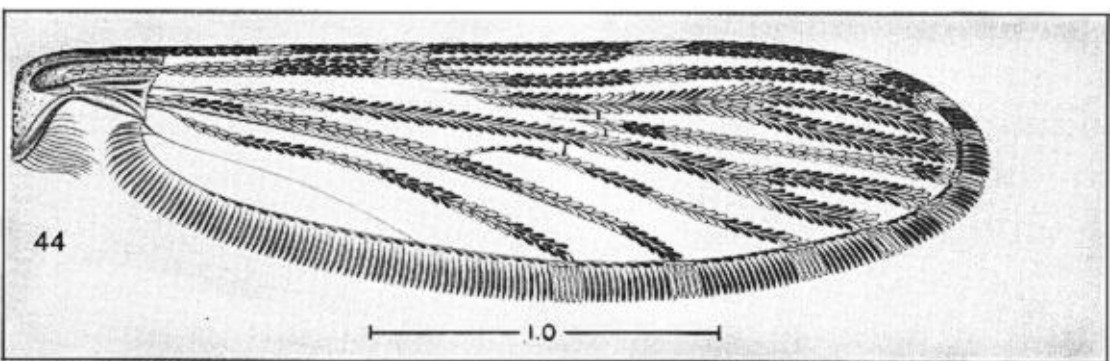
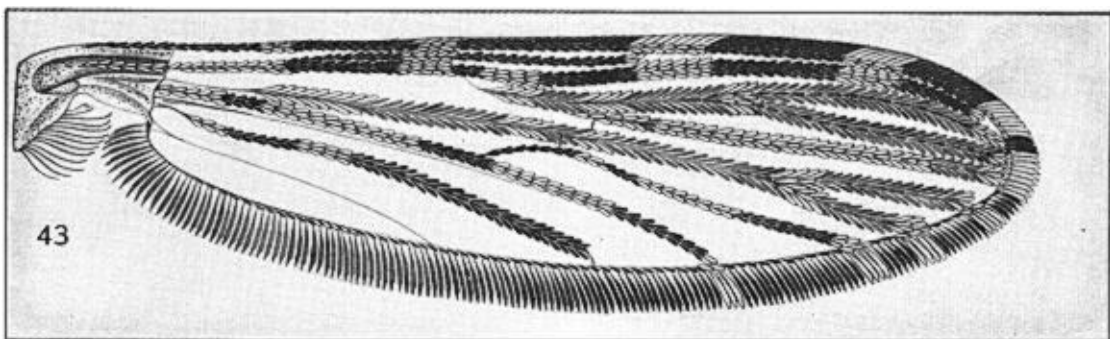
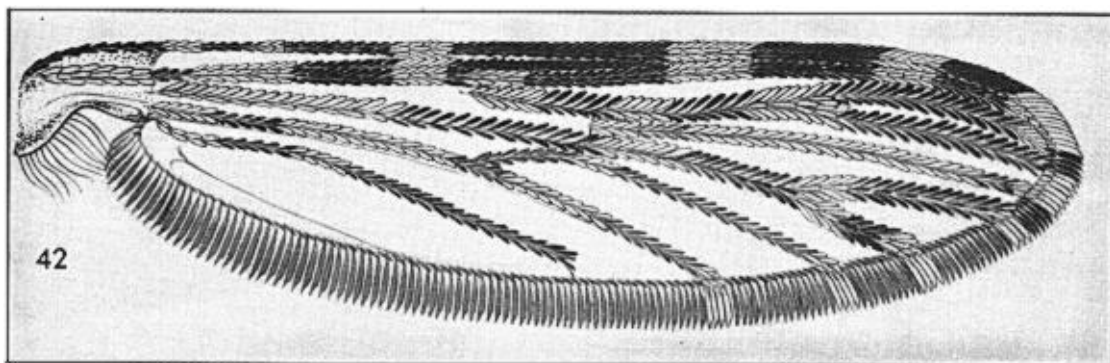
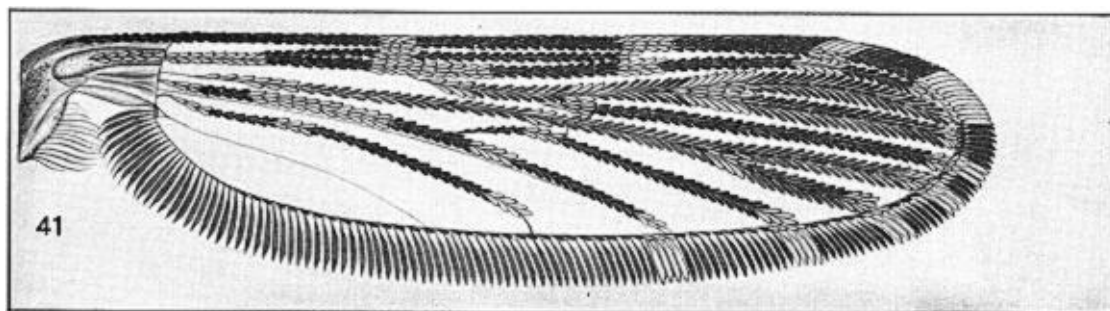


PLATE XII.

Wings and mesonotum.

- Fig. 45. *A. (Cellia) filipinae*.
46. *A. (Cellia) culicifacies*.
47. *A. (Cellia) fluviatilis*.
48. *A. (Cellia) jeyporiensis candidiensis*.
49. *A. (Cellia) minimus*, and other related forms.

PLATE XII.

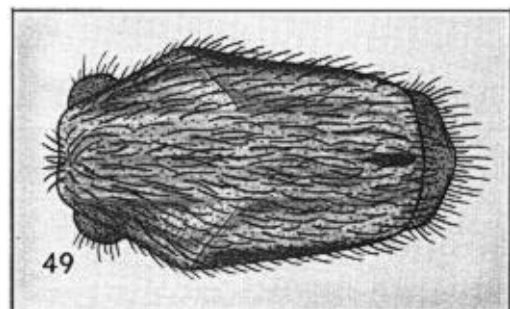
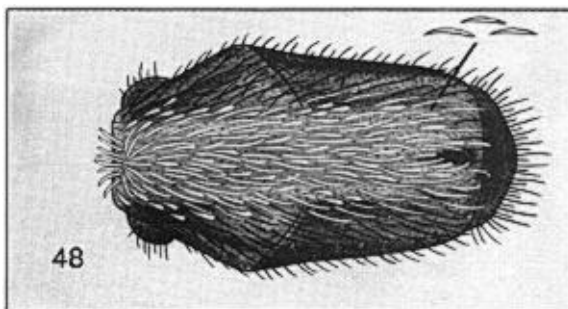
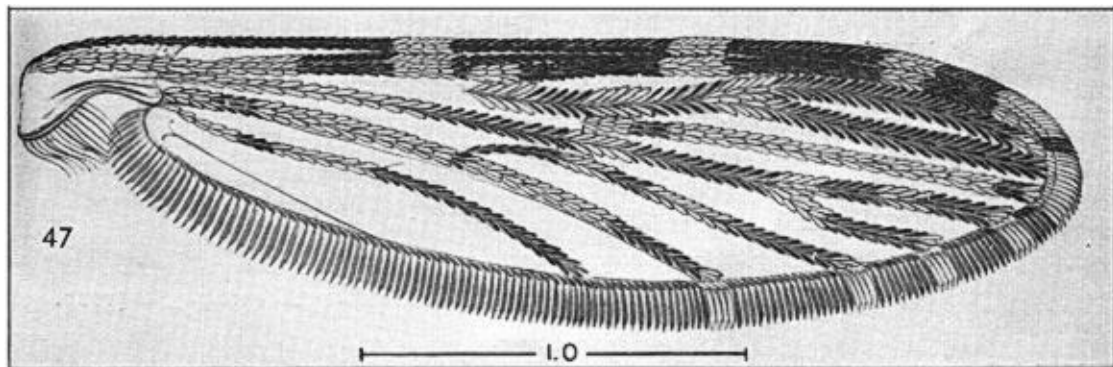
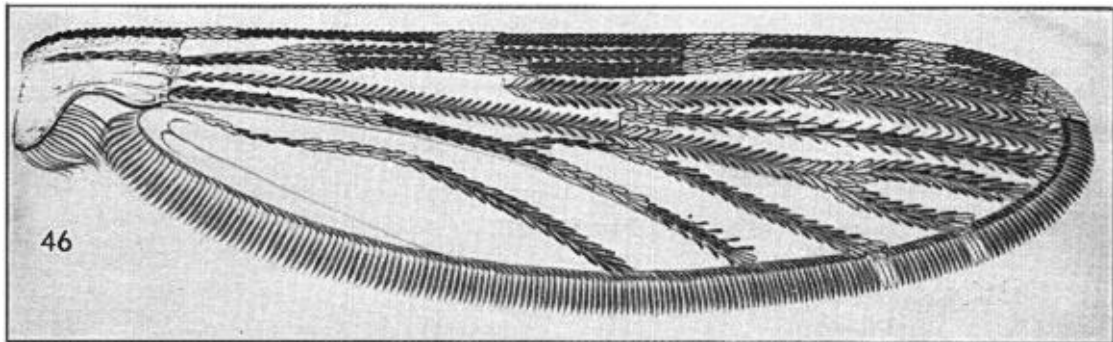
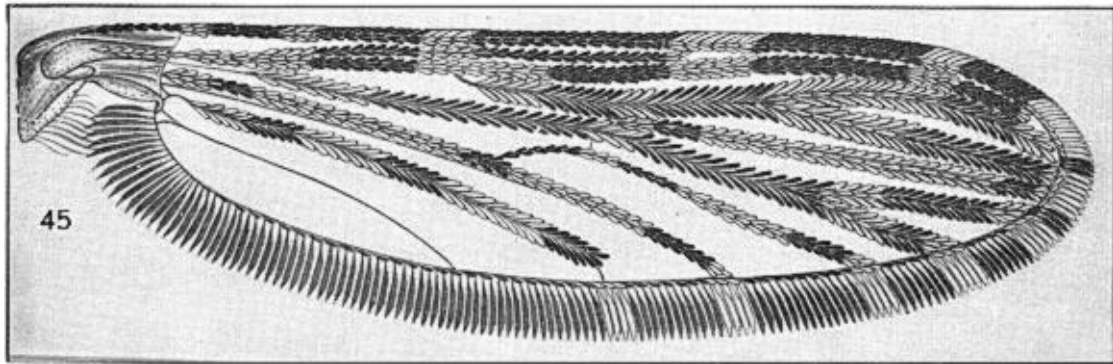


PLATE XIII.

Palps.

- Fig. 50. *A. (Anopheles) annandalei interruptus*.
51. *A. (Anopheles) asiaticus*.
52. *A. (Anopheles) barbirostris*, and other forms.
53. *A. (Anopheles) nigerrimus*, and other members of *hyrcanus* group.
54. *A. (Anopheles) separatus*.
55. *A. (Cellia) splendidus*.
56. *A. (Cellia) ramsayi*, and *jamesii*.
57. *A. (Cellia) pujutensis*.
58. *A. (Cellia) hackeri*.
59. *A. (Cellia) riparis macarthuri*, and other members of *leucosphyrus* group.

PLATE XIII.

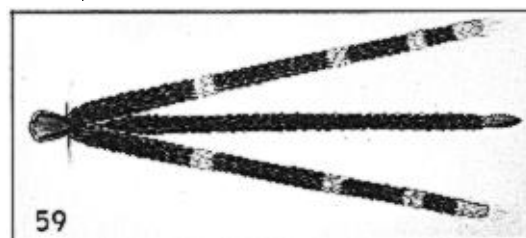
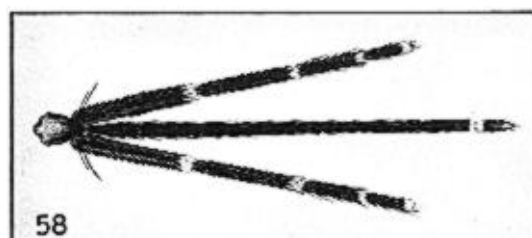
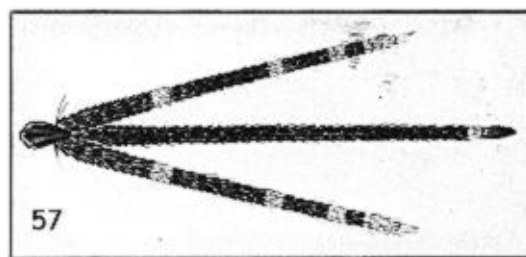
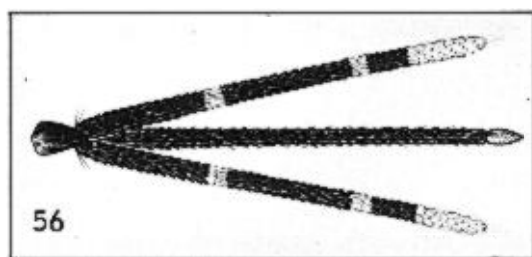
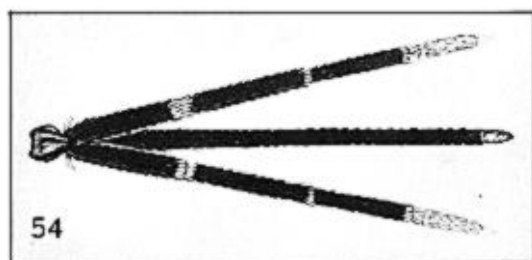
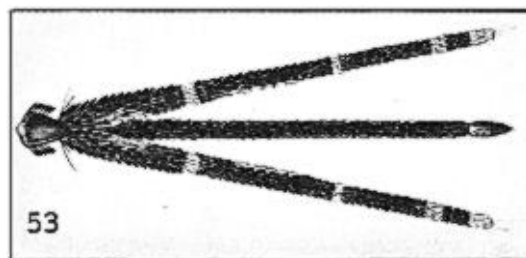
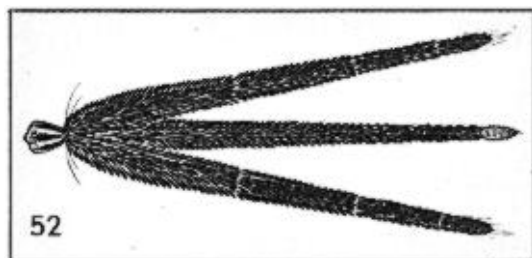
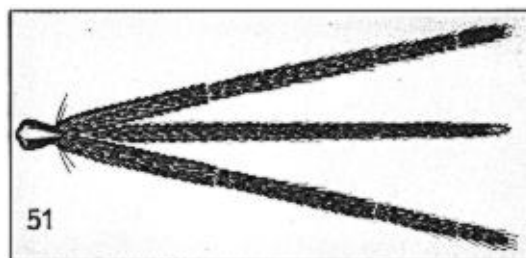
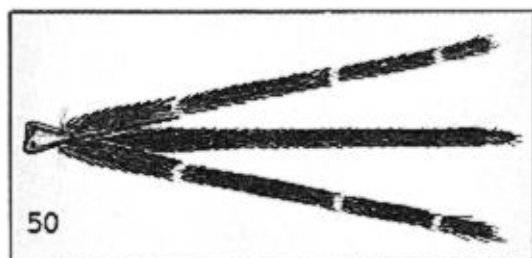


PLATE XIV.

Palps.

- Fig. 60. *A. (Cellia) tessellatus*.
61. *A. (Cellia) stephensi*.
62. *A. (Cellia) sundaicus*.
63. *A. (Cellia) karwari*.
64. *A. (Cellia) vagus*.
65. *A. (Cellia) subpictus*.
66. *A. (Cellia) culicifacies*.
67. *A. (Cellia) fluviatilis*.
68. *A. (Cellia) aconitus*.
69. *A. (Cellia) filipinae*, and other related forms.

PLATE XIV.

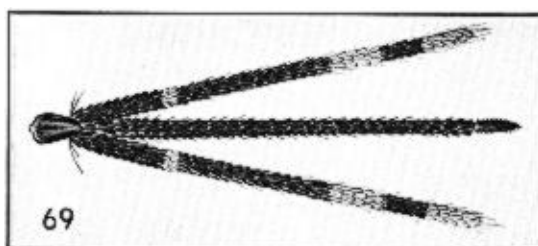
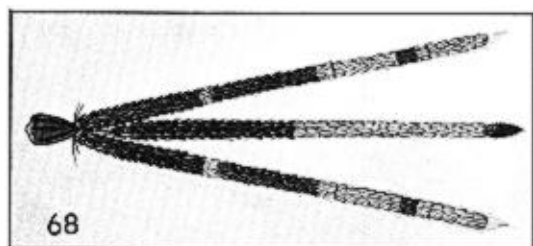
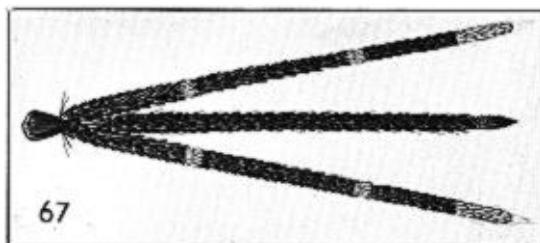
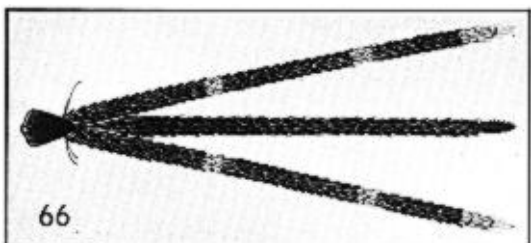
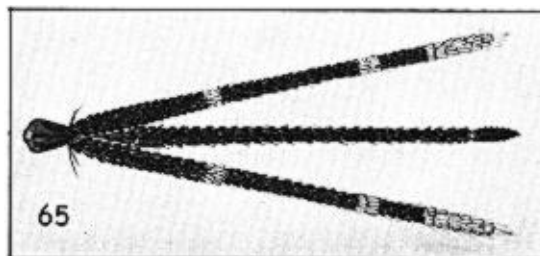
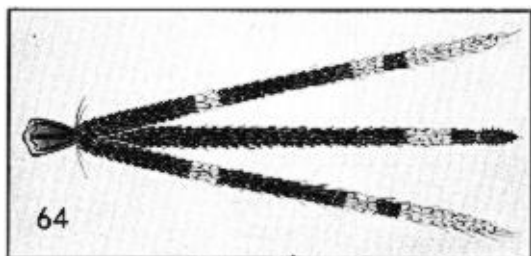
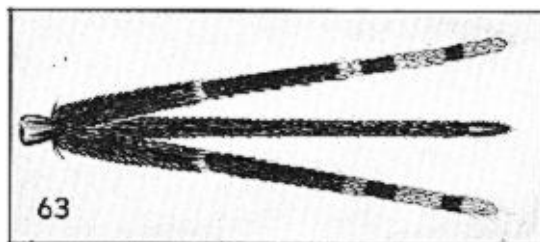
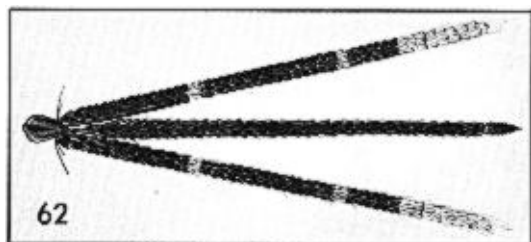
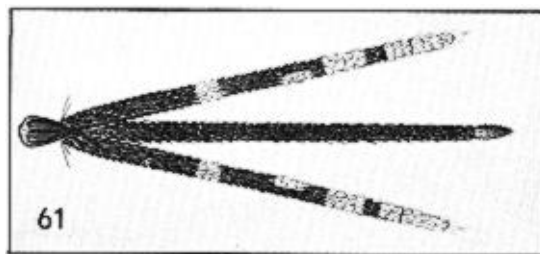
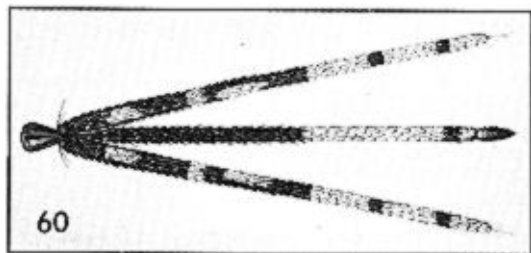


PLATE XV.

Fore, mid and hind legs.

- Fig. 70. *A. (Anopheles) annandalei interruptus* and *asiaticus*.
71. *A. (Anopheles) barbirostris*, and *campestris*.
72. *A. (Anopheles) hodgkini*, and other related forms.
73. *A. (Anopheles) pollicaris*.
74. *A. (Anopheles) donaldi*.
75. *A. (Anopheles) hodgkini*.
76. *A. (Anopheles) montanus*.
77. *A. (Anopheles) baezai*.
78. *A. (Anopheles) roperi*.
79. *A. (Anopheles) letifer*.
80. *A. (Anopheles) sinensis*.

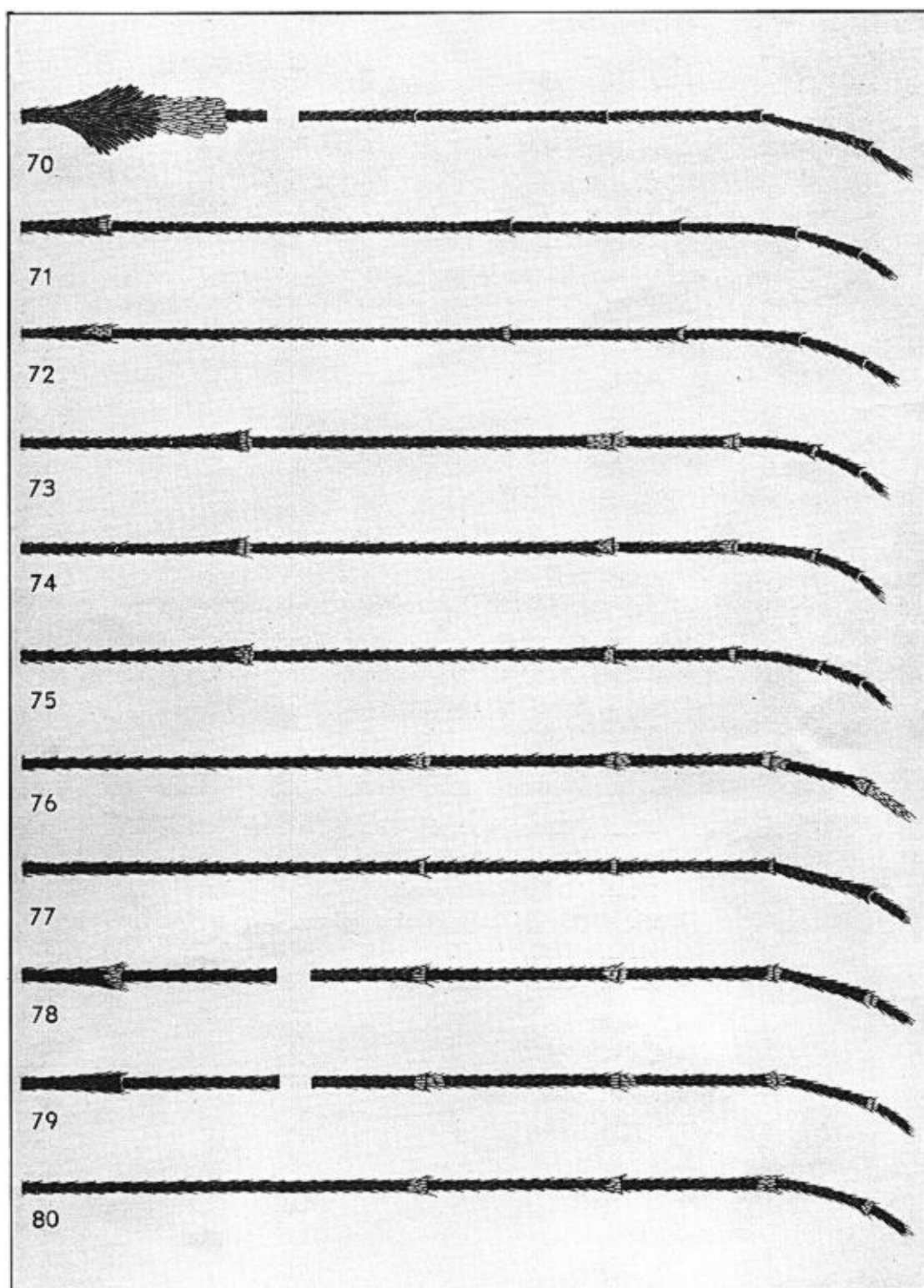


PLATE XVI.

Fore and hind legs.

- Fig. 81. *A. (Anopheles) argyropus*, (with variation).
82. *A. (Anopheles) peditaeniatus*.
83. *A. (Anopheles) peditaeniatus*.
84. *A. (Anopheles) nigerrimus*.
85. *A. (Anopheles) nigerrimus*.
86. *A. (Cellia) jamesii*.
87. *A. (Cellia) ramsayi*.
88. *A. (Cellia) maculatus*.
89. *A. (Cellia) balabacensis*.
90. *A. (Cellia) balabacensis introlatus*.
91. *A. (Cellia) kochi*.
92. *A. (Cellia) tessellatus*.

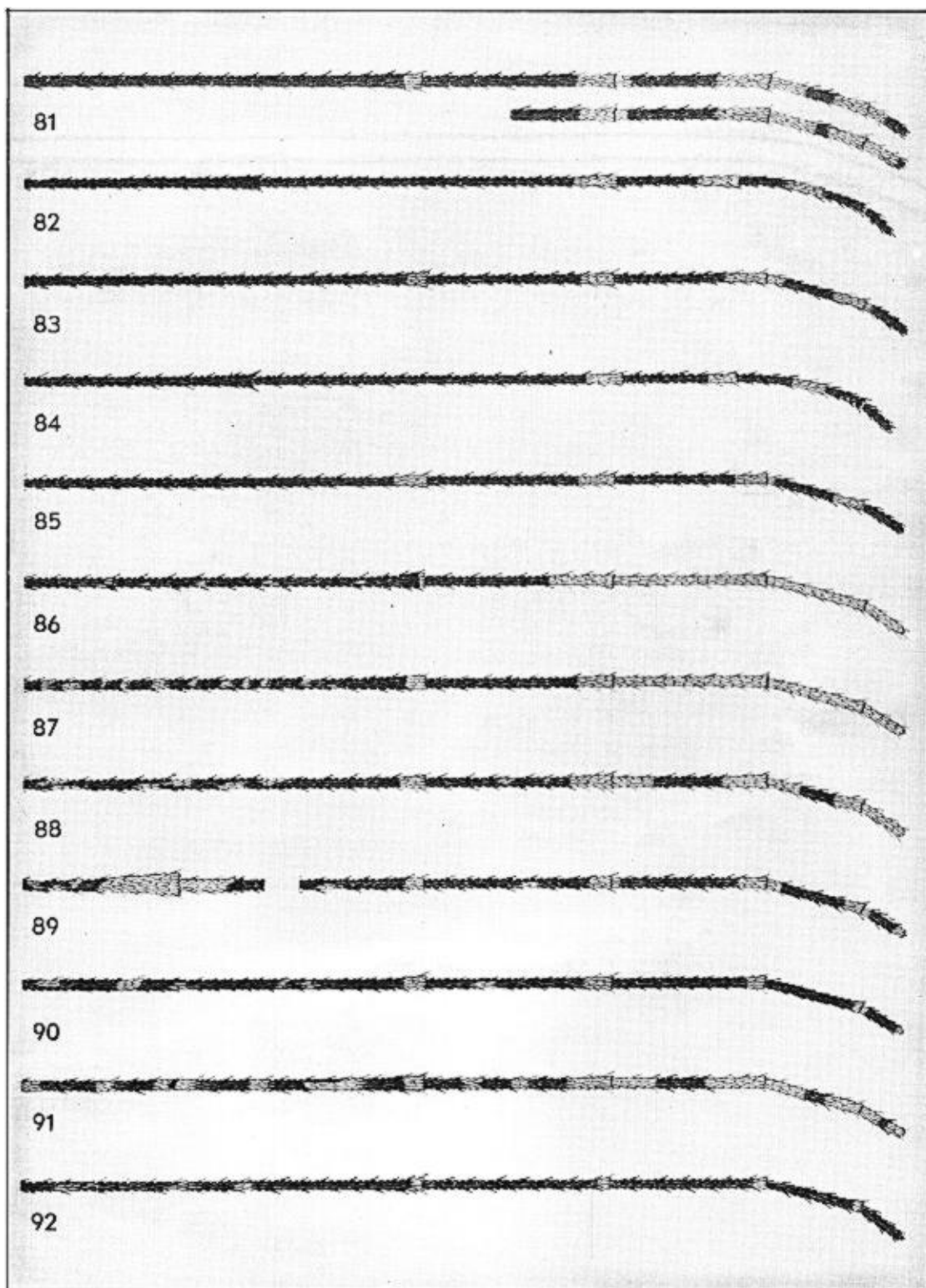


PLATE XVII.

Fore and hind legs, and abdominal sternites IV—V.

- Fig. 93. *A. (Cellia) karwari*.
94. *A. (Cellia) philippinensis*.
95. *A. (Cellia) pallidus*.
96. *A. (Cellia) vagus*.
97. *A. (Cellia) jeyporiensis candidiensis*.
98. *A. (Cellia) vagus*.
99. *A. (Cellia) jeyporiensis candidiensis*.
100. *A. (Cellia) pampanai*.
101. *A. (Cellia) minimus*, and other related forms.
102. *A. (Anopheles) campestris*.
103. *A. (Anopheles) barbirostris*.
104. *A. (Anopheles) donaldi*.
105. *A. (Anopheles) hodgkini*.

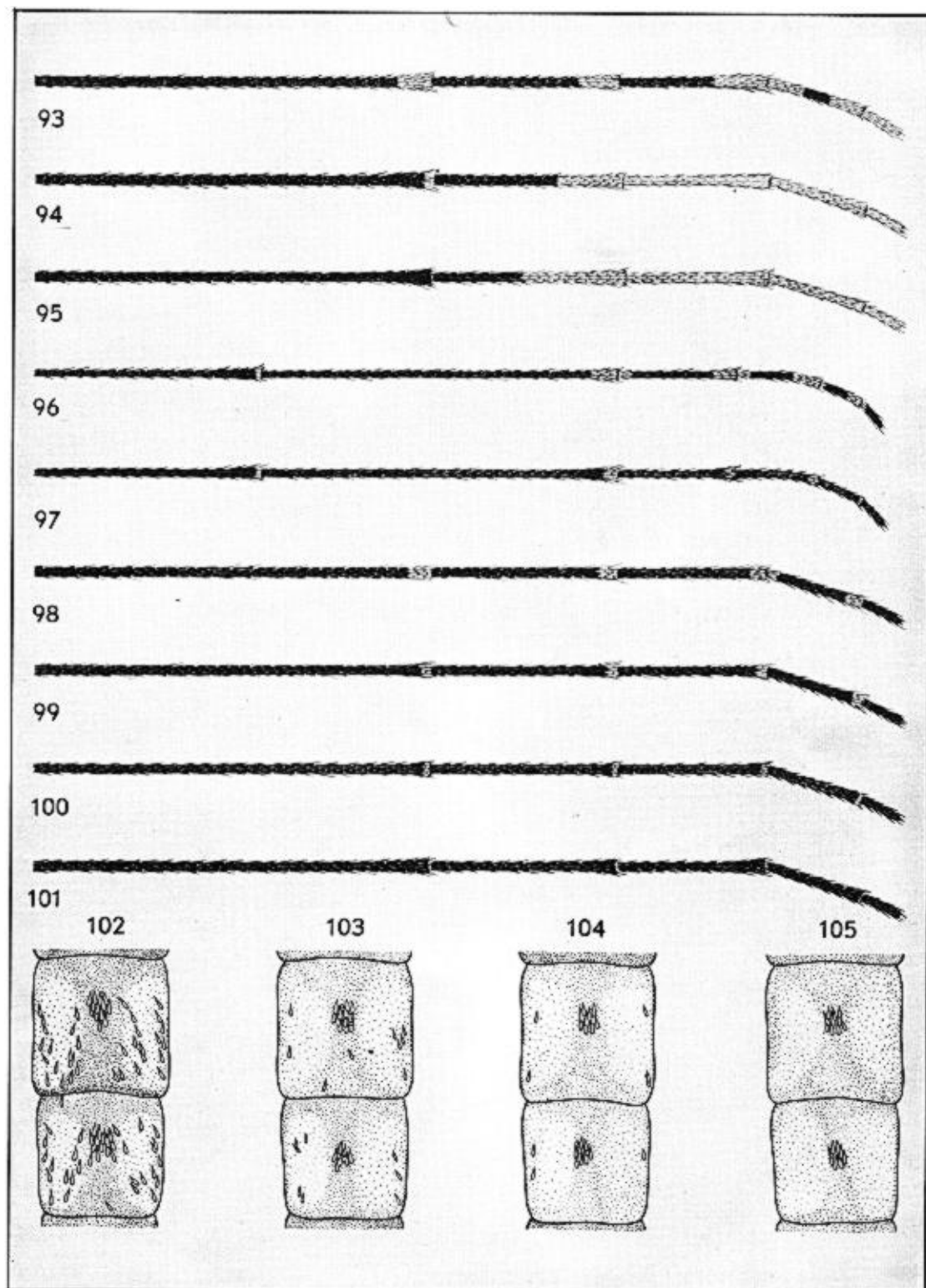


PLATE XVIII.

Wings and abdominal segments.

- Fig. 106. Generalized wing showing dorsal wing venation.
107. Dorsal aspect of *Anopheles* wing illustrating the wing spots used in the key.
108. *A. (Anopheles) barbirostris*, and *hyrcanus* groups.
109. *A. (Cellia) kochi*.
110. *A. (Cellia) jamesii*.
111. *A. (Cellia) ramsayi*.

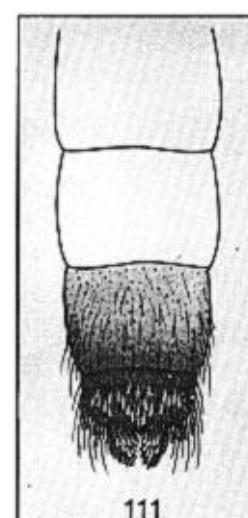
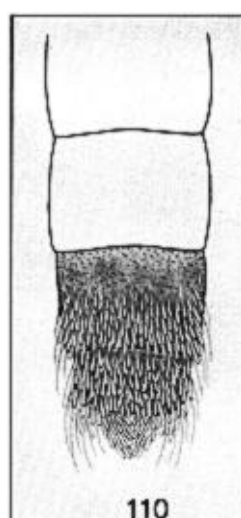
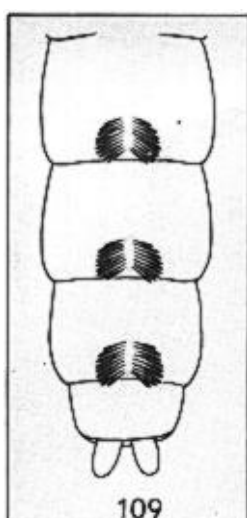
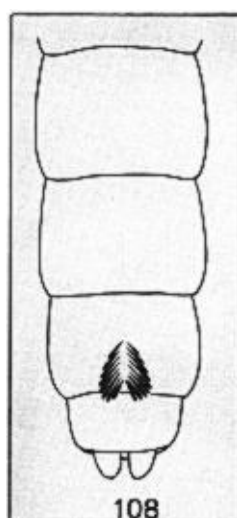
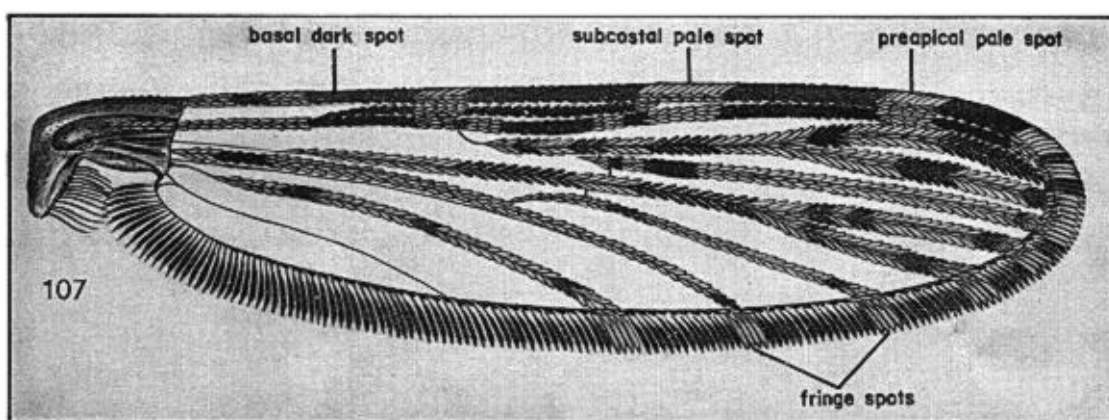
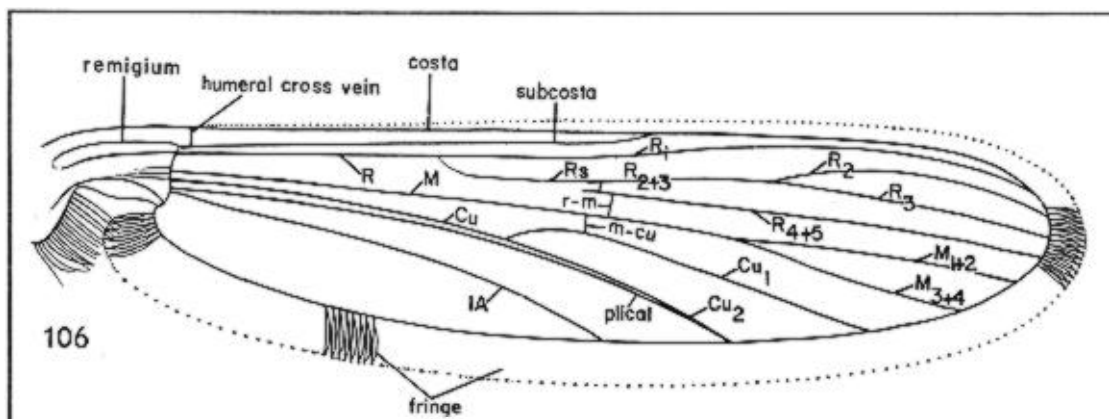


PLATE XIX.

Fig. 112. Generalized adult female, lateral aspect. Showing location of features used in key.

